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FINAL ENVIRONMENTAL STATEMENT



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PROPOSED MINING

Helena, Montana 59601

AND

RECLAMATION PLAN

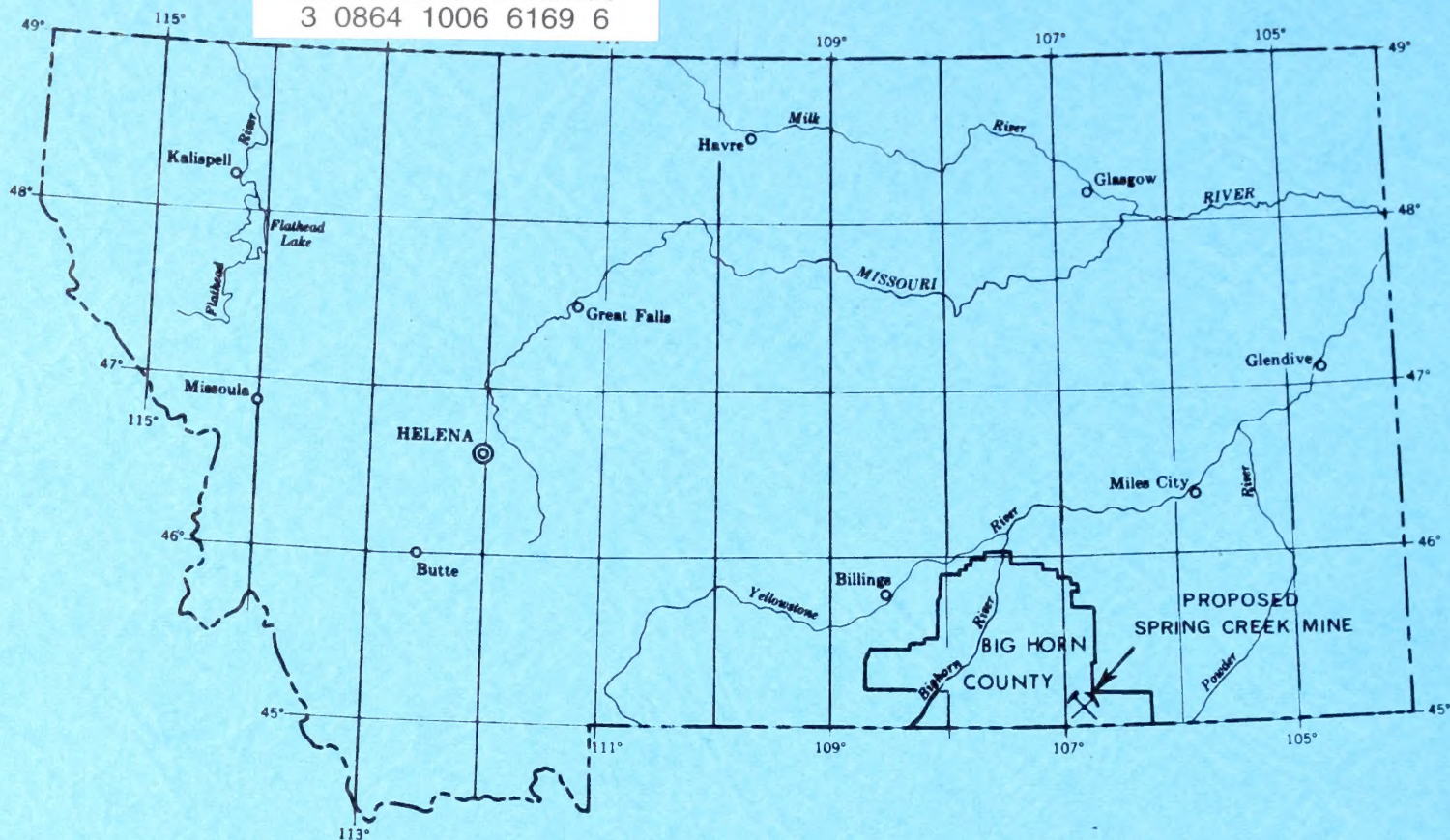


SPRING CREEK MINE

Big Horn County, Montana



3 0864 1006 6169 6



INDEX MAP OF MONTANA

50 0 50 100 Miles

ENGLISH-METRIC CONVERSION FACTORS

To convert English unit	Multiply by	To obtain Metric unit
Inches (in)-----	2.54	Centimeters (cm).
Feet (ft)-----	3.048×10^1	Centimeters (cm).
	3.048×10^{-1}	Meters (m).
Miles (mi)-----	1.609	Kilometers (km).
Square feet (ft ²)-----	9.290×10^{-2}	Square meters (m ²).
Acres-----	4.047×10^{-1}	Hectares (ha).
	4.047×10^{-3}	Square kilometers (km ²).
Acre-feet (acre-ft)-----	1.233×10^3	Cubic meters (m ³).
	1.233×10^{-3}	Cubic hectometers (hm ³).
Cubic yards (yd ³)-----	7.646×10^{-1}	Cubic meters (m ³).
Pounds (lb)-----	4.536×10^{-1}	Kilograms (kg).
Short tons (tons)-----	9.072×10^{-1}	Metric tons (t).
Pounds per acre (lb/acre)	1.12	Kilograms per hectare (kg/ha).
Btu/lb-----	2.326	Kilojoules per kilogram (kJ/kg).
Gallons (gal)-----	3.785×10^{-3}	Cubic meters (m ³).
Gallons per minute (gal/min)-----	6.309×10^{-2}	Liters per second (L/s).
Degrees Fahrenheit (°F)--	(¹)	Degrees Celsius (°C).

¹Temperature in °C =(temperature in °F - 32)/1.8.

U.S. DEPARTMENT OF THE INTERIOR
MONTANA DEPARTMENT OF STATE LANDS

PLEASE RETURN

FINAL

ENVIRONMENTAL STATEMENT

PROPOSED MINING AND RECLAMATION PLAN

SPRING CREEK MINE

SPRING CREEK COAL COMPANY

(A subsidiary of Northern Energy Resources Company, Inc.)

BIG HORN COUNTY, MONTANA

ON FEDERAL LEASE M-069782

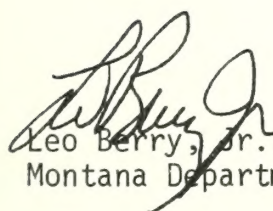
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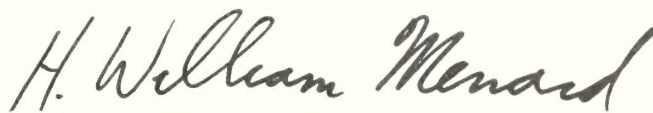
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U.S. Geological Survey, Department of the Interior

Montana Department of State Lands


Leo Berry, Jr., Commissioner
Montana Department of State Lands


H. William Menard, Director
U.S. Geological Survey



Spring Creek FES Errata

Correction:

Page IX-7, Response A to Letter 1, line 10 --
delete "... and State..." to read "... Federal regulatory
authorities ..."

Rationale:

The Montana Strip and Underground Mine Reclamation Act, under which the Department of State Lands regulates the strip mining of coal, does not authorize the Department to disapprove a mining and reclamation plan for failure to comply with the National Historic Preservation Act of 1966. Therefore, the Department can not withhold its decision contingent upon completion of the 106 process.

The Department does recognize the value of the cultural resources in the Spring Creek mine area and is requiring the company to supply the Department with information which closely parallels the information necessary to complete the 106 process.

Correction:

Page IX-132, Response E to Letter 29, line 1 --
response should read, "The placement of 'topsoil' and spoils at Decker has not been monitored closely enough to determine the probability of sodium contamination of surface materials."
The remainder of the response is correct as printed.

PREFACE

This statement was prepared by the U.S. Department of the Interior-Geological Survey, lead Federal agency--and the State of Montana--Department of State Lands, lead State agency--and represents a joint analysis of the environmental impacts of the proposed new coal-resource development by Spring Creek Coal Company. The statement considers the impacts which would be generated if all necessary permits were issued by the appropriate regulatory authorities in accordance with the company's proposals.

In order to clearly depict the changes which have been made in the text of the final environmental statement (FES) from the draft environmental statement (DES), a system of underlining has been used to indicate the substantive changes. These changes were necessitated either by responses to comments on the DES or by new information or explanations obtained subsequent to the issuance of the DES. The most notable of the substantive changes, made in response to the receipt of new information, is the discussion and analysis in chapter VIII of the amended Central Field mine plan. In all reality, this mine plan represents the proposal under which the company is pursuing permits for the Spring Creek mine. It should be noted, however, that the company may seek a permit amendment, at some future date, allowing them to mine at a rate and in a fashion similar to the mine plan discussed in chapter I.

It must be stressed that neither the Montana Department of State Lands nor the Office of Surface Mining have made a final determination ascertaining the compliance of the company's Central Field mine plan proposal with the Montana Strip and Underground Mine Reclamation Act and the Surface Mining Control and Reclamation Act, respectively.



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SUMMARY

() Draft

(X) Final Environmental Statement

Department of the Interior, U.S. Geological Survey

Montana Department of State Lands

1. Type of action: (X) Administrative () Legislative

2. Brief description of action (original mine plan):

State and Federal actions involve either approval or denial of permits for the proposed surface mining and reclamation plan Spring Creek mine, Big Horn County, Montana, submitted by the Spring Creek Coal Company. The company proposes to open a new mine, complete with plant, loading facilities, haul and access roads, and railroad spur, extending northwestward from the Decker mine. An estimated 243 million tons of low-sulfur coal would be removed from an area of about 1,850 acres within the 4,420-acre permit area over a period of about 25 years. The production would be 10 million tons per year.

3. Summary of adverse, unavoidable environmental impacts:

- A. Mining would create a broad, gently-sloping topographic surface in disequilibrium with the surrounding landscape. Severe erosion of the regraded highwalls and intercepted drainages would increase sediment yield to the reclaimed mine area about fivefold.
- B. Shallow aquifers, including the alluvium of South Fork Spring Creek, and other stratigraphic beds would be destroyed within the 1,850-acre mine area and replaced with an admixture of unconsolidated overburden material devoid of its original texture, permeability, and structure.
- C. Local ground-water quality would be lowered. The water table would be lowered to the east of the permit area possibly causing one well to become unusable.
- D. Mining and coal transport operations would cause short-term localized reduction in ambient air quality. Federal primary standards and Montana State guidelines for maximum allowable 24-hour concentrations of total suspended particulates would be exceeded several times per year.
- E. Soils would be disturbed on approximately 4,400 acres causing a reduction in soil structure and diversity, infiltration, hydraulic conductivity, and moisture holding capacity and an increase in bulk density, alkalinity, and soluble salts.

Disturbed areas would experience unavoidable long-term loss of potential productivity until complete rehabilitation is accomplished.

- F. Approximately 4,400 acres of grazing land would be unusable until reclamation is completed. The loss of vegetation diversity and replacement of shrubby species by grasses would decrease the carrying capacity for wildlife and livestock.
- G. The existing diverse habitat would be destroyed and replaced by topographic features and plant species not generally suitable for deer, antelope, sage grouse, and other species currently inhabiting the area. The impacts probably will be long-term. Game birds and animals would be displaced and the population of songbirds, rodents and reptiles would decrease.
- H. In-migration of employee population to the Birney-Sheridan area would adversely affect the quality of life of those living in the area. This would occur through subtle as well as acute impingements on both social and psychological well-being of individuals, and on social organization.
- I. Increased vehicular traffic between the Spring Creek mine and Sheridan would cause periodic congestion and an increased number of accidents in addition to increased noise, dust, and gaseous pollution. Increased road maintenance would be required. Increased train traffic would cause further delays of automobile traffic until grade separations are constructed.
- J. Scenic views and open-space qualities would be locally degraded until reclamation is completed.

4. Alternatives considered:

- A. Administrative alternatives available to the Secretary of the Interior.
- B. Administrative alternatives available to State Agencies.
- C. Technologic alternatives available to Federal and State authorities.
- D. Technical alternatives proposed by the company.
- E. Alternate mining plan - Central Field Mine Plan.
(See parts 5 and 6 below.)
- F. Alternate mitigation measures.

5. Brief description of Central Field mine plan (Alternative E):

State and Federal actions involve the same considerations as those concerned with the "original mine plan." This plan would avoid mining of the alluvial valleys of Spring Creek and South Fork.

proposals are to mine an estimated 184 million tons of low-sulfur coal from an area of about 1,400 acres within a permit area of 3,074 acres over a 25-year period. The rate of production would be 7 million tons per year.

6. Summary of adverse, unavoidable impacts (Central Field mine plan):

- A. There would be an increase in sediment yield within the mine area during mining. However, the geomorphic stability of the reclaimed surface is anticipated to be greater than the surface under the original mine plan.
- B. The overburden stratigraphy would be destroyed within the 1,400-acre mine area. The coal aquifer would be locally replaced by an admixture of unconsolidated overburden material devoid of its original structure, texture, and permeability.
- C. Local ground-water quality would be lowered within the coal aquifer east of the mine area.
- D. Emissions of atmospheric pollutants, primarily fugitive dust, would be slightly lower than under the original mine plan. Federal and State standards for 24-hour concentrations of total suspended particulates would be exceeded several times a year downwind of the mine.
- E. Soils would be disturbed on approximately 3,000 acres. The probability of successful reclamation would be increased and depend partly on how effectively the problem of sodic overburden was treated. If unsuccessful several hundred acres would become sodic and unproductive.
- F. About 3,000 acres of existing vegetation and the existing vegetation mosaic would be progressively destroyed, over a 25-year period. Reestablishment of the vegetation mosaic would probably require several decades, and ponderosa pine would probably be lost as a self-sustaining regenerating population for the long term.
- G. About 3,000 acres of existing wildlife habitat and grazing land would be progressively destroyed. The carrying capacity of the entire permit area would be lowered for most species that currently inhabit or use the minesite; however, 30 percent less area would be affected than under the original mine plan.
- H. Impacts on society would not be substantially different than those generated by the original mine plan. There would be a reduction in the quality of life for the residents of the Birney-Sheridan area resulting from a breakdown in society and impingements on social and psychological well-being.

- I. Impacts on transportation systems and esthetics would be essentially the same under the amended mine plan as under the original mine plan.

SUMMARY ATTACHMENT I

Comments were solicited from the following agencies and organizations; written comments were received from those identified by an asterisk:

Federal agencies

Advisory Council on Historic Preservation*
Federal Energy Regulatory Commission*
Interstate Commerce Commission
U.S. Department of Agriculture:
 Forest Service*
 Soil Conservation Service*
U.S. Department of the Army; Corps of Engineers*
U.S. Department of Energy
U.S. Department of Health, Education, and Welfare*
U.S. Department of Housing and Urban Development*
U.S. Department of the Interior:
 Bureau of Indian Affairs*
 Bureau of Mines*
 Bureau of Reclamation*
 Fish and Wildlife Service*
 Heritage Conservation and Recreation Service*
 National Park Service*
 Office of Surface Mining*
U.S. Department of Labor:
 Mine Safety and Health Administration
U.S. Department of Transportation
U.S. Environmental Protection Agency

State and local agencies

Montana Bureau of Mines and Geology
Montana Department of Agriculture; Pesticide Division*
Montana Department of Community Affairs*
Montana Department of Fish and Game*
Montana Department of Environmental Sciences:
 Air Quality Bureau*
 Food and Consumer Safety Bureau*
Montana Department of Natural Resources
Montana Environmental Quality Council*
Montana Historical Society*
Office of the Governor of Montana
Office of the Governor of Wyoming
Sheridan Area Planning Agency
Sheridan County Commissioners
Sheridan County Planning Commission
Rosebud County Planning Director
Wyoming State Highway Department*

Applicant

Northern Energy Resources Company, on behalf of Spring Creek Coal Company*

Other organizations

ASARCO Incorporated*
Burlington Northern Railroad*
City of Gillette*
Milwaukee Railroad
Montana State University
Mountain Bell Telephone Company
Northern Cheyenne Research Project*
Northern Plains Resource Council
Old West Regional Commission
Powder River Basin Resource Council
Range Telephone Cooperative
Sheridan-Johnson Rural Electric Association
Sierra Club
Tongue River Electric Cooperative
Tri-County Ranchers Association*
University of Montana
VTN, Inc.
Yellowstone-Tongue Area Wide Planning Organization

CONTENTS

Preface-----	Page iii
Summary-----	v
Summary attachment I-----	ix
 Chapter I. Description of the proposed actions-----	 I-1
A. Federal, State, and county actions-----	I-1
B. Background and history-----	I-1
1. Purpose-----	I-3
2. Location-----	I-3
3. Ownership and use rights-----	I-6
4. Existing coal resource holdings, Spring Creek Coal company-----	I-6
5. Description of the coal resources-----	I-11
C. Proposals of the Spring Creek Coal Company-----	I-14
1. Construction of facilities-----	I-14
a. Access road-----	I-16
b. Railroad and powerline-----	I-16
c. Structures-----	I-18
d. Fuel and explosive storage-----	I-18
e. Coal processing and storage facilities-----	I-18
f. Water supplies and waste disposal-----	I-19
g. Haul roads-----	I-19
h. Water diversion and impoundment-----	I-20
2. Mining and reclamation-----	I-23
a. Soil material removal and storage-----	I-26
b. Overburden removal-----	I-30
c. Coal drilling, blasting, and removal-----	I-30
d. Reclamation-----	I-32
1) Spoil reclamation-----	I-32
2) Topsoil redistribution-----	I-32
e. Postmining stream reclamation-----	I-35
f. Ponds-----	I-35
g. Seeding-----	I-35
3. Abandonment of mine-----	I-39
4. Employment requirements-----	I-39
D. Additional requirements to meet State and Federal regulations-----	I-39
1. General-----	I-39
2. Construction-----	I-41
3. Mining-----	I-42
4. Reclamation-----	I-42
5. Abandonment-----	I-44
 Chapter II. Description of the environment-----	 II-1
A. Geology-----	II-1
1. Topography and geomorphology-----	II-1
2. Stratigraphy and overburden-----	II-1
3. Structure-----	II-5

	Page
Chapter II. Description of the environment--Continued	
A. Geology--Continued	
4. Minerals other than coal-----	II-8
5. Paleontology-----	II-8
B. Hydrology-----	II-8
1. Surface water-----	II-8
a. Sediment-----	II-10
b. Quality-----	II-10
2. Ground water-----	II-10
a. Alluvial aquifers-----	II-11
b. Anderson-Dietz aquifer-----	II-12
c. Clinker aquifer-----	II-12
d. Canyon aquifer-----	II-12
C. Climate-----	II-11
1. Subregional climatic factors-----	II-13
a. Precipitation-----	II-13
b. Temperature-----	II-15
c. Wind-----	II-15
d. Microclimate-----	II-18
D. Air Quality-----	II-18
E. Soils-----	II-20
1. The soil resource-----	II-20
2. Current and potential use-----	II-23
F. Vegetation-----	II-23
1. Vegetation mosaic-----	II-23
a. Forests-----	II-29
b. Scrub-----	II-29
c. Grassland-----	II-30
d. Steppe-----	II-31
2. Rare and endangered species-----	II-31
3. Noxious weeds-----	II-31
G. Wildlife-----	II-31
1. Habitat-----	II-31
2. Large mammals-----	II-31
a. Antelope-----	II-31
b. Mule deer-----	II-32
c. White-tailed deer-----	II-35
3. Other mammals-----	II-35
4. Upland game birds-----	II-35
5. Raptors-----	II-37
6. Songbirds-----	II-37
7. Amphibians and reptiles-----	II-39
8. Endangered species-----	II-39
9. Fisheries-----	II-39
H. Sociology-----	II-39
1. Population-----	II-40

Chapter II. Description of the environment--Continued

Page

H. Sociology--Continued

2. Social organization and ongoing social
impacts-----

II-44

a. Big Horn County-----

II-46

b. Sheridan County, Wyoming-----

II-48

I. Economics-----

II-49

1. Introduction-----

II-49

2. Employment-----

II-49

3. Income-----

II-52

4. Tax structure, revenues, and expenditures-----

II-56

5. Economic projections without Spring Creek-----

II-60

6. Severance tax-----

II-62

7. Crow economics-----

II-62

8. Northern Cheyenne economics-----

II-63

J. Community services-----

II-63

1. Housing-----

II-63

2. Water-----

II-65

a. Sheridan-----

II-65

b. Dayton-----

II-68

c. Ranchester-----

II-68

d. Rural-----

II-68

e. Decker-----

II-70

3. Wastewater treatment-----

II-70

a. Introduction-----

II-70

b. Sheridan-----

II-70

c. Ranchester-----

II-71

d. Sheridan and Big Horn Counties-----

II-71

4. Solid waste-----

II-71

a. Sheridan-----

II-71

b. Sheridan County-----

II-73

c. Big Horn County-----

II-73

5. Schools-----

II-73

a. Sheridan County-----

II-73

1) District 1-----

II-73

2) District 2-----

II-75

6. Health care-----

II-75

a. Health care facilities-----

II-75

b. Health care personnel-----

II-76

c. Nursing and retirement homes-----

II-76

7. Law enforcement-----

II-76

a. Sheridan-----

II-76

b. Ranchester-----

II-76

c. Dayton-----

II-76

d. Sheridan County-----

II-77

e. Big Horn County-----

II-77

8. Fire protection-----

II-77

K. Land use-----

II-78

1. Present use-----

II-78

	Page
Chapter II. Description of the environment--Continued	
K. Land use--Continued	
2. Land use planning-----	II-78
a. Federal planning-----	II-78
b. Local land use planning-----	II-78
1) Sheridan County-----	II-78
2) Big Horn County-----	II-81
L. Transportation system-----	II-81
1. Highways-----	II-81
2. Railroads-----	II-83
3. Other transportation-----	II-83
M. Recreation-----	II-86
1. Outdoor recreation-----	II-87
2. Urban recreation-----	II-87
N. Cultural resources-----	II-89
1. Archeology-----	II-89
2. Historical overview-----	II-91
a. Big Horn and Sheridan Counties-----	II-91
1) Crow Indians-----	II-92
2) Northern Cheyenne Indians-----	II-93
O. Esthetics-----	II-93
Chapter III. Probable impact of the proposed action-----	III-1
A. Geology-----	III-1
1. Topography and geomorphology-----	III-1
2. Overburden-----	III-2
3. Paleontology-----	III-2
B. Hydrology-----	III-3
1. Surface water-----	III-3
2. Ground water-----	III-5
C. Climate-----	III-6
D. Air quality-----	III-6
1. Primary impacts-----	III-7
2. Biological air quality impacts-----	III-9
a. Deposition of dust on plant and soil surfaces-----	III-9
b. Wildlife and domestic animals-----	III-11
c. Terrestrial insects-----	III-11
d. Human effects-----	III-11
E. Soils-----	III-12
1. Reclamation-----	III-12
2. Site specific problems-----	III-13
3. General mining impacts-----	III-14
4. Postmining management-----	III-15
F. Vegetation-----	III-15
1. Rare and endangered species-----	III-17
G. Wildlife-----	III-17
1. Habitat-----	III-18

	Page
Chapter III. Probable impact of the proposed action--Continued	
G. Wildlife--Continued	
2. Large mammals-----	III-18
a. Antelope-----	III-18
b. Mule deer-----	III-18
c. White-tailed deer-----	III-19
3. Other mammals-----	III-19
4. Upland game birds-----	III-19
5. Raptors-----	III-20
6. Songbirds-----	III-20
7. Amphibians and reptiles-----	III-20
8. Endangered species-----	III-20
9. Fisheries-----	III-21
H. Sociology-----	III-21
1. Population-----	III-21
2. Social organization-----	III-22
a. Social well-being-----	III-22
b. Psychological well-being-----	III-24
I. Economics-----	III-25
1. Employment-----	III-25
2. Income-----	III-26
3. Fiscal conditions-----	III-28
4. Indians and Indian Reservations-----	III-28
J. Community services-----	III-30
1. Housing-----	III-30
2. Water-----	III-31
a. Sheridan-----	III-31
b. Ranchester-----	III-31
c. Dayton-----	III-31
d. Rural Sheridan County and Decker area-----	III-32
3. Wastewater treatement-----	III-32
a. Sheridan-----	III-32
b. Ranchester-----	III-32
c. Dayton-----	III-32
d. Rural Sheridan and Big Horn Counties-----	III-32
4. Solid waste-----	III-32
a. Sheridan-----	III-32
b. Big Horn County-----	III-32
5. Schools-----	III-33
6. Health facilities-----	III-33
a. Hospitals-----	III-33
b. Health personnel-----	III-33
c. Nursing-----	III-34
7. Law enforcement-----	III-34
8. Fire protection-----	III-34
K. Land use-----	III-34
1. Local impacts-----	III-34
2. Regional impacts-----	III-35
3. Cumulative land use impacts-----	III-37

	Page
Chapter III. Probable impact of the proposed action--Continued	
K. Land use--Continued	
4. Impact on planning-----	III-37
L. Transportation systems-----	III-38
1. Highways-----	III-38
2. Railroads-----	III-39
3. Cumulative transportation impacts-----	III-39
M. Recreation-----	III-40
N. Cultural resources-----	III-41
O. Esthetics-----	III-41
Chapter IV. Mitigating measures-----	IV-1
Chapter V. Adverse impacts that cannot be avoided if the the proposals are implemented-----	V-1
Chapter VI. The relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity-----	VI-1
Chapter VII. Irreversible and irretrievable commitments of resources-----	VII-1
Chapter VIII. Alternatives to the proposed action-----	VIII-1
A. Administrative alternatives available to the Secretary of the Interior in relation to the proposed Federal action in this statement-----	VIII-1
1. No action-----	VIII-1
2. Defer Federal action-----	VIII-2
3. Prevent development of the lease-----	VIII-3
a. Reject the Spring Creek mining and reclamation plan-----	VIII-3
b. Seek legislation to cancel the lease-----	VIII-3
c. Exchange the existing lease-----	VIII-4
d. Suspend operations-----	VIII-5
e. Federal reacquisition of leased rights-----	VIII-6
4. Restrict development on the lease-----	VIII-6
5. Require modification of the plan to improve it technically and reduce anticipated impacts of the operation-----	VIII-6
6. Allow development of selected areas now under lease-----	VIII-7
B. Administrative alternatives available to State agencies-----	VIII-8
1. Department of State Lands-----	VIII-8
2. Department of Health and Environmental Sciences--	VIII-9
3. Department of Natural Resources and Conservation--	VIII-9
C. Technical alternatives-----	VIII-9
1. Configuration of the proposed mine area-----	VIII-10
2. Mining procedures-----	VIII-10

Chapter VIII. Alternatives to the proposed actions--Continued

Page

C. Technical alternatives--Continued	
3. Coal production rates-----	VIII-11
4. Coal transportation system-----	VIII-11
D. Technical alternatives proposed by the company-----	VIII-12
1. Highwall reduction-----	VIII-12
a. Case 1-----	VIII-12
b. Case 2-----	VIII-12
c. Case 3-----	VIII-15
d. Impacts from the proposed highwall reductions-----	VIII-15
E. Alternate mining plan - Central Field mine plan-----	VIII-17
1. Background-----	VIII-17
2. Proposals of the Spring Creek Coal Company-----	VIII-18
a. Construction of facilities-----	VIII-18
b. Mining-----	VIII-25
1) Topsoil removal and storage-----	VIII-27
2) Overburden and coal removal-----	VIII-29
c. Reclamation-----	VIII-30
1) Spoil reclamation-----	VIII-30
2) Postmining topography and reestablishment of ephemeral drainages-----	VIII-32
3) Topsoil redistribution and topsoil amendments-----	VIII-35
4) Planting and revegetation-----	VIII-37
3. Description of the environment-----	VIII-40
4. Environmental impacts of the proposal-----	VIII-40
a. Geology-----	VIII-40
1) Topography and geomorphology-----	VIII-40
a) During mining-----	VIII-40
b) Postmining-----	VIII-41
2) Overburden and stratigraphy-----	VIII-43
3) Paleontology-----	VIII-44
b. Hydrology-----	VIII-44
1) Surface water-----	VIII-44
2) Ground water-----	VIII-44
c. Air quality-----	VIII-45
1) Fugitive dust-----	VIII-46
2) Gaseous emissions-----	VIII-52
d. Soils-----	VIII-52
e. Vegetation-----	VIII-55
f. Wildlife-----	VIII-56
1) Antelope-----	VIII-57
2) Mule deer-----	VIII-57
3) Other mammals-----	VIII-57
4) Upland game birds-----	VIII-57
5) Raptors-----	VIII-57
6) Songbirds-----	VIII-58

Chapter VIII. Alternatives to the proposed actions--Continued	
E. Alternate mining plan - Central Field mine plan--Continued	
4. Environmental impacts of the proposal--Continued	
f. Wildlife--Continued	
7) Amphibians and reptiles-----	VIII-58
g. Sociology-----	VIII-58
1) Population-----	VIII-58
h. Economics-----	VIII-59
1) Employment and income-----	VIII-59
2) Fiscal conditions-----	VIII-60
a) Sheridan County-----	VIII-60
b) Big Horn County-----	VIII-61
i. Esthetics-----	VIII-61
j. Cultural resources-----	VIII-61
F. Alternate mitigation measures-----	VIII-62
1. Geology-----	VIII-62
2. Hydrology-----	VIII-63
3. Air quality-----	VIII-63
4. Soils-----	VIII-64
a. Management alternatives-----	VIII-64
b. Selective salvage of overburden-----	VIII-64
c. Detailed soil characterization-----	VIII-65
5. Vegetation-----	VIII-66
a. Fertilizer-----	VIII-66
b. Seedbed preparation-----	VIII-66
c. Seeding-----	VIII-66
d. Post-seeding management-----	VIII-67
6. Wildlife-----	VIII-68
7. Social and economic-----	VIII-68
a. County mitigation-----	VIII-69
b. Corporate mitigation-----	VIII-69
c. Federal assistance-----	VIII-69
8. Community services-----	VIII-70
9. Transportation-----	VIII-71
10. Recreation-----	VIII-72
11. Esthetics-----	VIII-73
Chapter IX. Consultation and coordination-----	IX-1
A. Preparation of the document-----	IX-1
B. Review of the document-----	IX-2
C. Comment letters and responses-----	IX-5
D. Public hearings: Summary of principle comments-----	IX-149
Chapter X. References-----	X-1

	Page
Chapter XI. Appendixes:	
A. Overburden characteristics at the Spring Creek mine---	XI-3
B. Summary of ground water quality-----	XI-11
D-1. Atmospheric particulate high-volume sampling, Decker-Shell-Spring Creek units-----	XI-12
D-2. Atmospheric visibility, Crow Reservation Shell lease-----	XI-13
D-3. Theoretical maximum particulate emissions at a 10 million-ton-per-year mine-----	XI-14
D-4. Potential human health effects from exposure to atmospheric particulates (Dr. Dale Bergren)-----	XI-15
D-5. Potential particulate emissions at 7 million tons of coal production-----	XI-19
D-6. Regional coal dust emissions off unit-trains-----	XI-21
D-7. Gaseous emission factors-----	XI-22
E-1. Subgroup classification of soil series-----	XI-23
E-2. Profile descriptions of soil series-----	XI-24
E-3. Soil chemistry-----	XI-32
F-1. Complete plant species list-----	XI-35
F-2. Annual biomass increment by community and functional group-----	XI-46
F-3. Range condition by community-----	XI-49
G-1. Wildlife species list-----	XI-50
G-2. U.S. Fish and Wildlife Service letter regarding eagle nest sites, Spring Creek area-----	XI-56
I-1. Montana and Wyoming taxes-----	XI-58
I-2. "Coal Town II" model projections, Big Horn and Sheridan Counties-----	XI-69
N. State Historic Preservation Officer letter to Bureau of Land Management regarding cultural resources-----	XI-76
O. Visual management rating system-----	XI-81
Q. Department of State Lands letter outlining de- ficiencies of the original mining and reclamation plan-----	XI-83
R. Department of State Lands letter outlining de- ficiencies of the Central Field mine plan-----	XI-104
S. Department of State Lands letter regarding alluvial valley floor determination-----	XI-117
T. Correspondence regarding cultural resource compliance-----	XI-122

ILLUSTRATIONS

	Page
Figure I-1. Index map of the Spring Creek coal field-----	I-4
I-2. General location map of Spring Creek coal leases-	I-5
I-3. Map showing distribution of surface ownership----	I-7

Figure	I-4. Map showing public minerals ownership-----	I-8
	I-5. Map showing private non-coal minerals ownership --	I-9
	I-6. Federal oil and gas lease map-----	I-10
	I-7. Isopach map of coal thickness-----	I-12
	I-8. Map showing proposed railroad corridor and access road-----	I-15
	I-9. Map showing mine facilities for the Spring Creek mine-----	I-17
	I-10. Map showing drainage plan-----	I-21
	I-11. Diagrams showing diversion channel construction---	I-22
	I-12. Cross section showing typical dam construction---	I-24
	I-13. Map showing the proposed progression of mining within Federal coal lease M-069782-----	I-25
	I-14. Map showing the progression of mining by year and locations of overburden and topsoil storage-----	I-27
	I-15. Cross section of highwall reduction-----	I-28
	I-16. State bonding map for mining disturbance-----	I-29
	I-17. Isopach map showing overburden thickness-----	I-31
	I-18. Fill area isopach for truck and shovel stripping--	I-33
	I-19. Postmining topography-----	I-34
	I-20. Map showing proposed reclamation vegetation-----	I-38
	II-1. Topographic map of the Spring Creek area-----	II-2
	II-2. Regional geologic map showing the Spring Creek area-----	II-3
	II-3. Geologic column of the Spring Creek coal field---	II-4
	II-4. Locations of test holes in the Spring Creek permit area-----	II-6
	II-5. Annual precipitation profiles-----	II-14
	II-6. Three-year running averages of precipitation at Billings and Decker-----	II-16
	II-7. Annual wind rose for Spring Creek-----	II-17
	II-8. Air monitoring stations in the Spring Creek area--	II-19
	II-9. Map showing soil series and associations-----	II-22
	II-10. Map showing land capability classes-----	II-25
	II-11. Map showing vegetation communities-----	II-27
	II-12. Major antelope use areas-----	II-33
	II-13. Major mule deer use areas-----	II-34
	II-14. Grouse wintering and breeding areas-----	II-36
	II-15. Raptor nest locations-----	II-38
	II-16. Population cycles in Sheridan and Big Horn Counties-----	II-41
	II-17. Natural rural communities, Big Horn County-----	II-47
	II-18. Ages of housing in Sheridan-----	II-66
	II-19. Building permits for new construction, Sheridan 1965-77-----	II-66

	Page
Figure II-20. Average daily traffic on regional roads and highways-----	II-82
II-21. Major railroads serving the Powder River region-----	II-84
II-22. Traffic of the rail system serving the proposed Spring Creek mine, 1977-----	II-85
II-23. Map of Tongue River Reservoir showing existing recreational facilities-----	II-88
II-24. Map showing cultural resource surveys of the Spring Creek area-----	II-90
III-1. Comparison of records of the Decker high-volume air sampling station to Spring Creek and Youngs Creek records for the same period, 1976-----	III-8
VIII-1. Case 1 - Highwall reduction-----	VIII-13
VIII-2. Case 2 - Highwall reduction-----	VIII-14
VIII-3. Case 3 - Highwall reduction-----	VIII-16
VIII-4. Stream diversions on Spring Creek-----	VIII-20
VIII-5. Drainage plan map-----	VIII-21
VIII-6. Cross section of sediment control dam-----	VIII-23
VIII-7. Drainage ditch cross sections-----	VIII-24
VIII-8. Mine facilities and mining sequence-----	VIII-26
VIII-9. State bonding level map-----	VIII-28
VIII-10. Reclamation sequence-----	VIII-31
VIII-11. Postmining recontoured surface-----	VIII-33
VIII-12. Reclaimed stream cross sections-----	VIII-34
VIII-13. Revegetation plan map-----	VIII-39
VIII-14. Baseline average annual total suspended particulate concentrations-----	VIII-48
VIII-15. Projected average annual total suspended particulate concentrations-----	VIII-49
VIII-16. Baseline average annual dustfall-----	VIII-50
VIII-17. Projected average annual dustfall-----	VIII-51

TABLES

	Page
Table I-1. Permit requirements and authorizing Federal, State and local government agencies-----	I-2
I-2. Coal trace element analysis-----	I-13
I-3. Seeding mixtures-----	I-36
I-4. Spring Creek project work force schedule-----	I-40
II-1. Overburden traits of the Spring Creek field, summary of drillhole average-----	II-7
II-2. Annual peak discharge for Spring Creek near Decker, Montana-----	II-9

	Page
Table II-3. Estimated peak discharge for Spring Creek and South Fork Spring Creek-----	II-10
II-4. Water wells in and near Spring Creek permit area---	II-11
II-5. Probability of large precipitation events-----	II-15
II-6. Total suspended particulate and settled particulate data characteristic of Spring Creek and vicinity--	II-18
II-7. Land capability classes of soils, Spring Creek-----	II-24
II-8. Physiognomic classes and associated vegetation communities of the Spring Creek area-----	II-26
II-9. Plant communities and associated soils-----	II-28
II-10. Wildlife habitat in Spring Creek permit area-----	II-32
II-11. Population change in Big Horn County area-----	II-42
II-12. Projected population changes without Spring Creek--	II-43
II-13. 1970 population characteristics for Sheridan County and Big Horn County-----	II-45
II-14. Employment by sector for 1975 in Big Horn County and Sheridan County-----	II-50
II-15. Unemployment rates -----	II-51
II-16. Total personal income, 1970-75, Big Horn and Sheridan Counties-----	II-52
II-17. Per capita income 1970-75, Sheridan County, Wyoming, and Big Horn County, Montana; and States of Montana and Wyoming-----	II-53
II-18. Sector earnings for 1975 in Big Horn and Sheridan Counties-----	II-54
II-19. Farm and ranch income 1970-75-----	II-55
II-20. Estimated revenue for Sheridan and Sheridan County 1977-78-----	II-58
II-21. Budgeted expenditures and estimated revenues for the city of Sheridan, Wyoming, fiscal years 1966 and 1975-----	II-59
II-22. Projected mine and ancillary employment through 1990, without Spring Creek mine, Big Horn and Sheridan Counties-----	II-61
II-23. Housing units in Big Horn County and Sheridan County, 1970 and 1976-----	II-64
II-24. Types of housing units in Sheridan area-----	II-65
II-25. Housing conditions in Sheridan County-----	II-67
II-26. Existing water systems-----	II-69
II-27. Existing sewage systems-----	II-72
II-28. 1976 school statistics for Big Horn County, Montana, and Sheridan County, Wyoming-----	II-74
II-29. Land use in Big Horn and Sheridan Counties-----	II-79
II-30. Land ownership in Big Horn and Sheridan Counties---	II-80
II-31. Rail traffic projections for selected BN line segments-----	II-86

	Page
Table II-32. Summary of cultural resource sites in the area of the proposed Spring Creek mine area-----	II-89
II-33. Summary of cultural resource sites eligible for the National Register of Historic Places-----	II-91
III-1. Estimated uncontrolled atmospheric emissions at the Spring Creek mine-----	III-10
III-2. Population projections with addition of Spring Creek mine-----	III-22
III-3. Mine employees residence (1978-90)-----	III-26
III-4. Employment projections, Big Horn and Sheridan Counties, 1978-90-----	III-27
III-5. Projected fiscal conditions with the Spring Creek mine-----	III-29
III-6. Unit trains per week past crossing-----	III-40
VIII-1. Acres disturbed during the first 5-year bonding period-----	VIII-27
VIII-2. Proposed seeding mixtures for the Spring Creek project sites-----	VIII-38
VIII-3. Actual annual particulate emissions from the Spring Creek mine after proposed dust control techniques are employed during 1985-----	VIII-47
VIII-4. Gaseous emissions from fuel combustion at the Spring Creek mine and vicinity during 1985-----	VIII-53
VIII-5. Population projections with addition of Spring Creek mine at 7 million tons per year-----	VIII-59

CHAPTER I

DESCRIPTION OF THE PROPOSED ACTIONS

A. FEDERAL, STATE, AND COUNTY ACTIONS

Several interrelated Federal, State, and county actions are involved in the approval or denial of applications for permits, stemming from a proposal by Spring Creek Coal Company, to open a new coal mine on existing Federal coal leases in Big Horn County, Montana. To operate this proposed mine, Spring Creek Coal Co. must obtain both Federal and State surface mining and reclamation permits, in addition to other permits required for associated activities. Table I-1 shows these various activities and the respective administrative governmental agencies.

B. BACKGROUND AND HISTORY

In April 1976 the Secretary of the Interior directed that a regional impact statement be prepared covering proposed development on existing Federal coal leases in the Montana portion of the Powder River Basin, including all or parts of Custer, Rosebud, Treasure, Big Horn, and Powder River Counties, Montana.

A number of the coal-related actions in Montana are simultaneously pending before both Federal and State agencies. Because the requirements of the Montana Environmental Policy Act (MEPA) are essentially the same as those of the National Environmental Policy Act (NEPA), the State of Montana and the U.S. Geological Survey, as lead Federal agency, agreed (in 1976) to prepare the regional environmental statement jointly and thus meet their individual responsibilities in a single effort. The regional statement is expected to be published in draft form in 1979.

The regional statement analyzes several possible future levels of coal development, which take into account presently approved mining operations, a number of pending proposed mines, development of existing undeveloped Federal and State coal leases and privately owned coal resources. In addition, it includes action on pending lease applications for Federal coal to the extent that the Secretary is permitted to do so under judgements rendered in the case of NRDC vs. Hughes (Civil Action No. 75-1749, U.S. District Court for the District of Columbia). In its evaluation of cumulative impacts of coal development in the region, the regional statement specifically includes the impacts that would be generated by Spring Creek mine, should it be approved.

Under Montana's mining and reclamation laws, that State must render its decision on mining permit applications within an absolute maximum of 240 days after acceptance of a complete application. The application for the Spring Creek mine was submitted in August 1977. In order to accomplish the MEPA requirements and meet the statutory time constraints, and because the joint regional statement could not be concluded within that time frame, the State and Federal agencies have proceeded to prepare this site-specific impact statement on the Spring Creek mine as a separate and concurrent joint effort.

TABLE I-1.--Permit requirements and authorizing Federal, State,
and local government agencies*

Permit	Agency
Surface mining and reclamation	Office of Surface Mining U.S. Geological Survey Montana Department of State Lands
Rights-of-way for railroad, highway, powerline, and access road	Bureau of Land Management Montana Department of Natural Resources and Conservation Montana Department of Highways Big Horn County, Montana
Streambed construction and runoff retention	Army Corps of Engineers Montana Department of Health and Environmental Sciences Montana Department of Natural Resources and Conservation Big Horn Conservation District
Sewage, solid waste, and temporary oily waste disposal	Montana Department of Health and Environmental Sciences Big Horn County, Montana
Explosives manufacturing and storage	U.S. Treasury
Water supplies	Montana Department of Health and Environmental Sciences Montana Department of Natural Resources and Conservation
Building construction and housing	Montana Department of Administration Montana Department of Health and Environmental Sciences Big Horn County, Montana
Air quality emissions	Environmental Protection Agency Montana Department of Health and Environmental Sciences
High structures (radio tower and coal storage building)	Federal Aviation Administration
Radio transmission	Federal Communication Commission

*Table I-1 has been revised from the draft.

The mining and reclamation plans described in this statement were prepared on the basis of information and maps furnished by Spring Creek Coal Co. to the U.S. Geological Survey and the Montana Department of State Lands for a new coal mining operation on BLM Lease Montana-069782 in Big Horn County, Montana. The proposed plans are intended to comply with pertinent Federal, State, and county laws and must comply and be approved if Spring Creek Coal Co. is to operate such a mine in Montana.

THE MINING AND RECLAMATION PLAN INCLUDED IN THIS STATEMENT WAS SUBMITTED FOR REVIEW PRIOR TO THE PROMULGATION OF INITIAL REGULATIONS (30 CFR 700) REQUIRED UNDER SECTIONS 502 AND 523 OF THE SURFACE MINING CONTROL AND RECLAMATION ACT (SMCRA) OF 1977 (PUBLIC LAW 95-87) AND THE EMERGENCY REGULATIONS PROMULGATED UNDER THE MONTANA STRIP AND UNDERGROUND MINE RECLAMATION ACT OF 1973, PART 2, CHAPTER 4, TITLE 82, MCA. The application has not been officially reviewed for compliance therewith; therefore, the company's mining and reclamation plan may not reflect the initial requirements of these regulations.

THE MINING AND RECLAMATION PLAN HAS BEEN RETURNED TO THE OPERATOR WITH A REQUEST THAT IT BE REVISED IN ACCORDANCE WITH THE APPLICABLE REGULATIONS. IN RESPONSE TO THIS REQUEST, THE COMPANY SUBMITTED A ~~PRELIMINARY~~ MODIFICATION OF THE MINE PLAN IN ~~APRIL~~ AUGUST 1978, WHICH IS BE ADDRESSED IN CHAPTER VIII. As soon as the reclamation plan is officially revised and submitted to the Office of Surface Mining (OSM) and the Montana Department of State Lands, it will be evaluated to determine compliance with the requirements of Federal and State regulations. The mining and reclamation plan will not be approved until it conforms to these requirements and all other applicable Federal and State regulations.

1. Purpose

Spring Creek Coal Co. proposes to mine approximately 243 million tons of the 287-million-ton deposit of low-sulfur (0.75 lb/million Btu) subbituminous coal over a 25-year period, from an area to be known as the Spring Creek mine, encompassing a Federal coal lease of 2,346.76 acres within a Montana State permit application area of 4,420 acres. Coal from this mine would be transported by unit-train to electric-power generation plants. The company has a contract commitment to provide 7 million tons of coal per year to Utility Fuels, Inc., a subsidiary of Houston Industries, Inc., of Texas. The purpose of this environmental statement is to analyze the foreseeable and potential environmental consequences of mining and reclamation according to the proposed plan.

2. Location

The proposed permit area is in Big Horn County, Montana, approximately 8 miles north of the Montana-Wyoming border (figs. I-1 and I-2). The nearest major town is Sheridan, Wyoming, 28 miles south via Montana Federal Aid Secondary (FAS) Route 314 and Wyoming Route 338; Decker, Montana, is approximately 11 miles south on Montana FAS Route 314. The

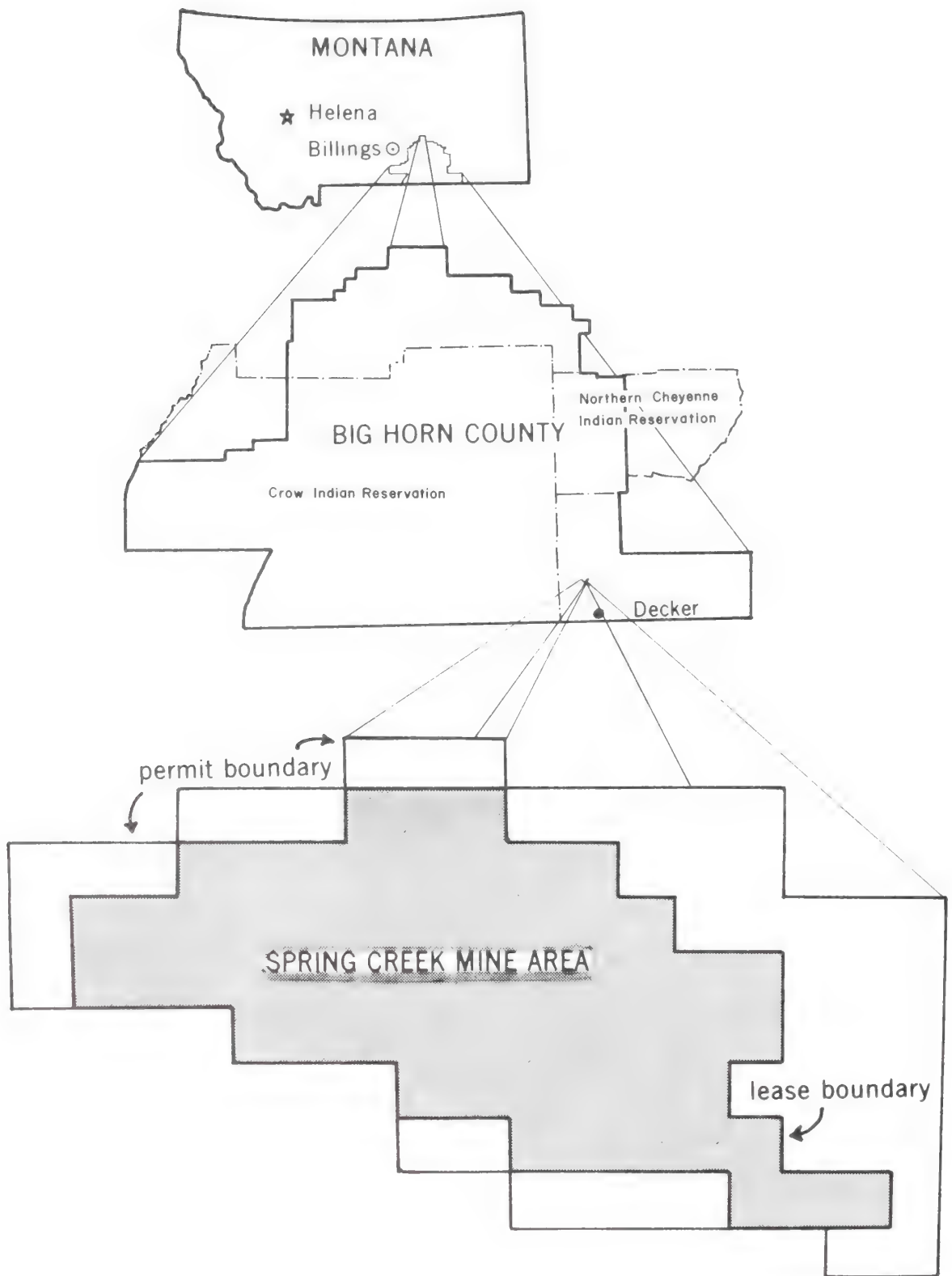


FIGURE I-1.--Index map of the Spring Creek coal field.

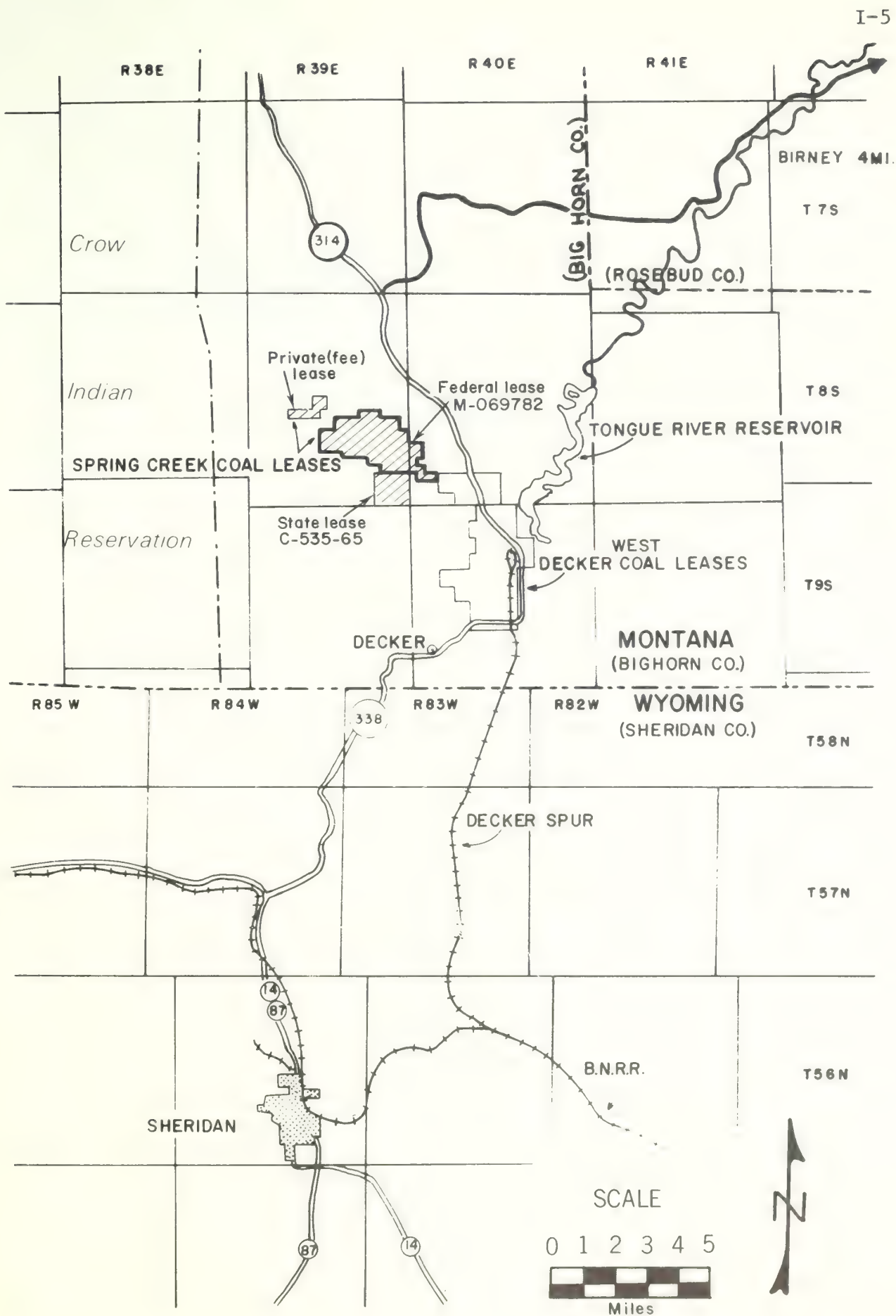


FIGURE I-2.--General location map of the Spring Creek coal leases.

Tongue River Reservoir and the proposed North Extension of the West Decker mine lies 4 miles east of the Spring Creek area. The West Decker mine proper lies 5 miles to the southeast. The Crow Indian Reservation boundary is about 3 miles west of the permit area, the Northern Cheyenne Reservation about 16 miles north.

3. Ownership and Use Rights

The pattern of land-surface and mineral ownership is complex within the permit area: about 320 acres of surface remain totally in Federal ownership, about 120 acres in State ownership, and about 3,980 in private ownership. However, additional small parcels of State and Federal land are crossed by the proposed access road and rail-utility corridor (fig. I-3), a powerline of Tongue River Electric Cooperative of Ashland, Montana, intersecting the latter (fig. I-4). Telephone lines of the Range Telephone Cooperative, Inc., of Forsyth, Montana, parallel FAS Route 314. If these lines are not relocated, they would be intersected at two points by the rail-utility corridor.

When lands in this general area were patented, coal was retained in Federal ownership under the entire permit area, except for the 120-acre tract in State section 36. Under those patented lands where the Federal Government reserved only coal (about half the permit area), rights to other minerals passed to the surface owner. The present pattern of public mineral ownership in the mine area and along the transportation corridors is shown in figure I-4; the tracts where minerals other than coal are held by private individuals or companies are shown in figure I-5.

Valuable hydrocarbons other than coal (oil and gas) have been sought in this area. Between 1955 and 1968, five dry holes were drilled along an east-west line about 1 mile to the south of the proposed Spring Creek mine. These wells were relatively shallow, the deepest reaching approximately 8,300 feet below the surface (Montana State Oil & Gas Conservation Board files, Billings). Oil and gas interest in the area is currently high; approximately 2,100 acres within the permit area are under nine Federal oil and gas leases. Four of these were issued between December 1, 1969, and October 1, 1976 (fig. I-6).

4. Existing Coal Resource Holdings, Spring Creek Coal Company

The coal ownership of the Spring Creek Coal Co. in Montana consists of 3,306.27 acres of coal lands under lease in the Spring Creek area. This coal is contained in three separate leases, two of which (Federal and State) are contiguous (fig. I-2). Federal lease Montana-069782, the subject of this EIS, encompasses 2,346.76 acres, and is joined to the south by Montana State coal lease C-535-65, containing 640 acres. The third, a private coal lease of 320 acres, lies northwest of the other two leases and is separated from them by about 0.5 mile.

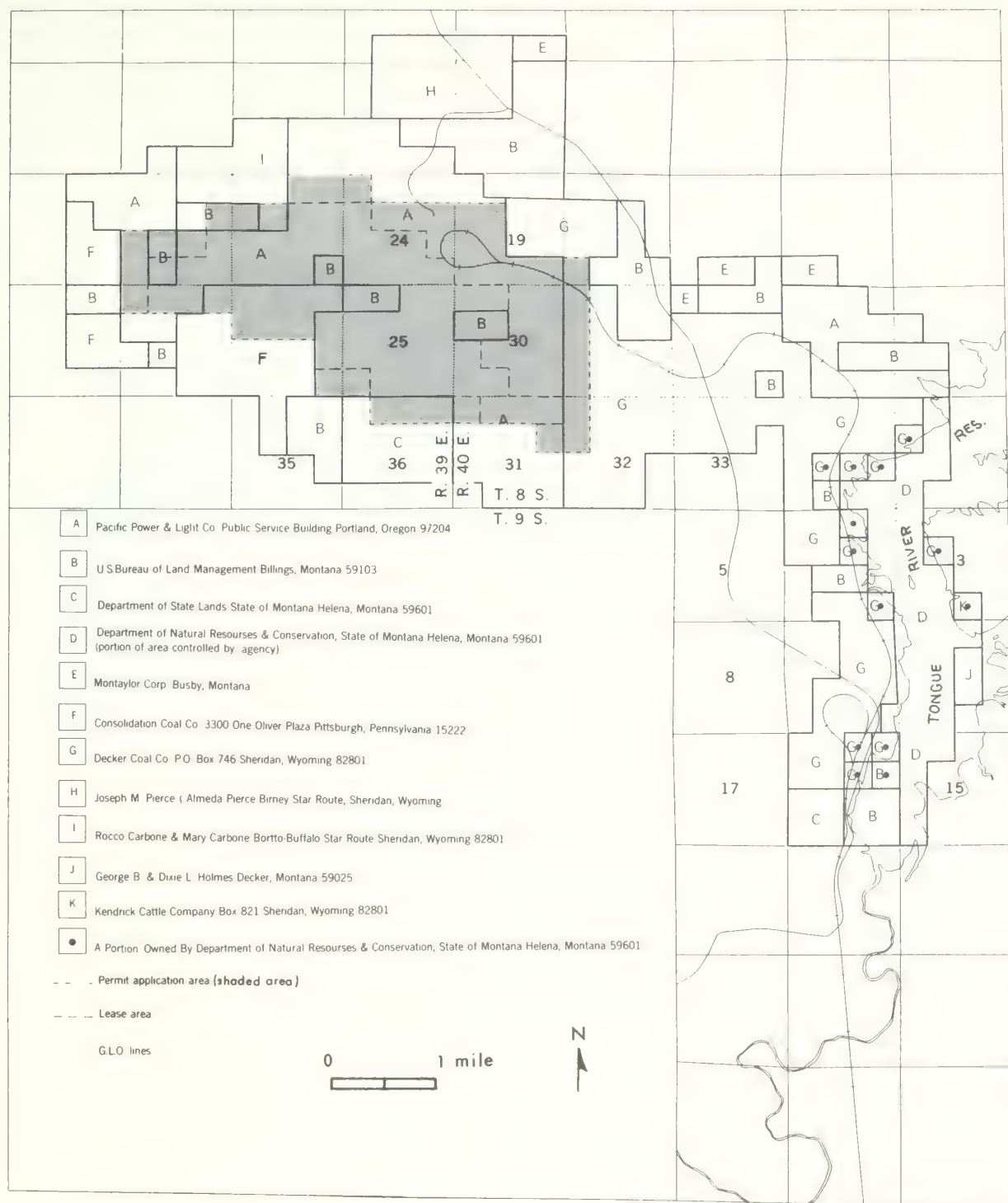


FIGURE I-3.--Map showing distribution of surface ownership (permit area is shaded).

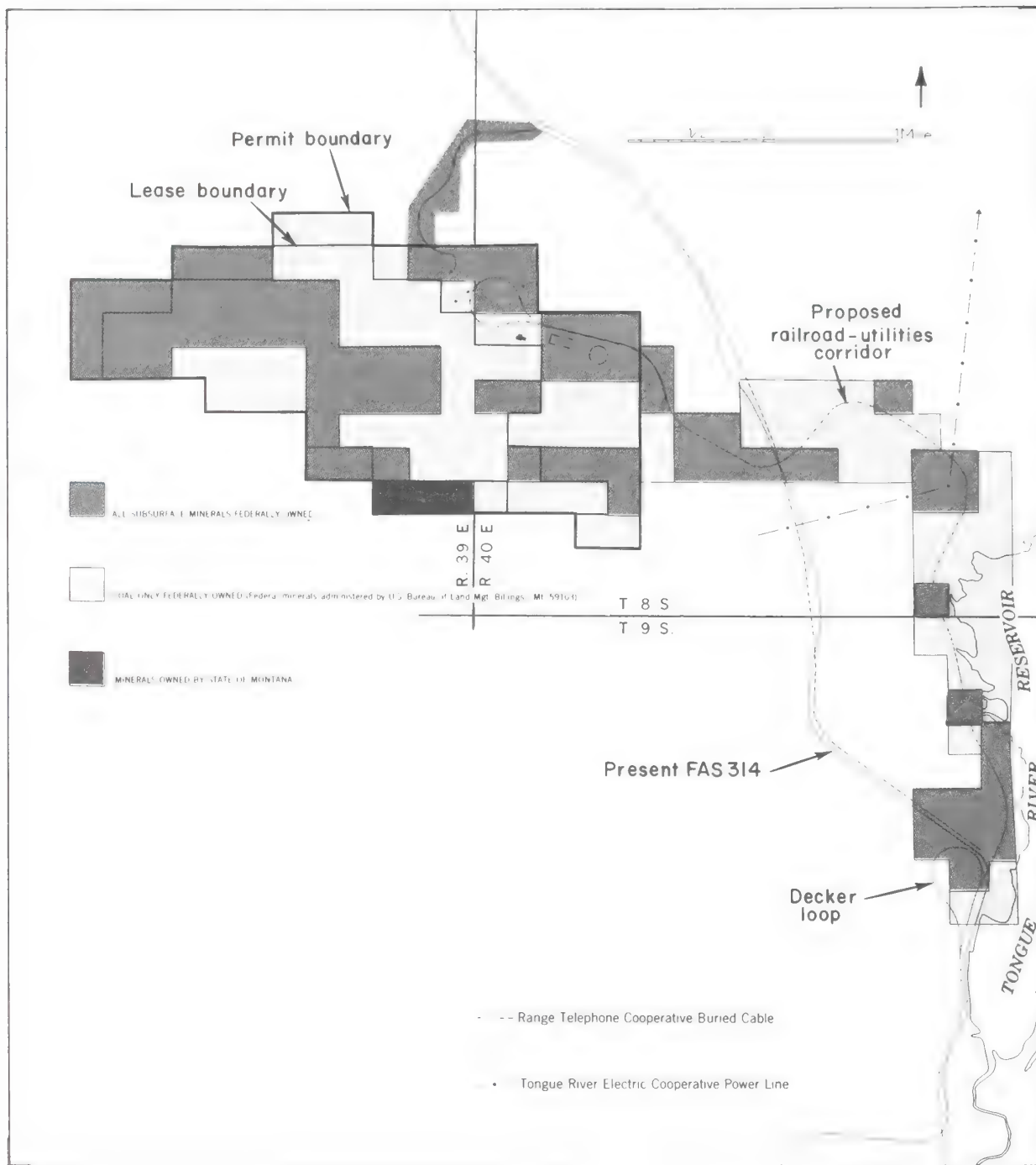


FIGURE I-4.--Map showing public minerals ownership (includes coal).

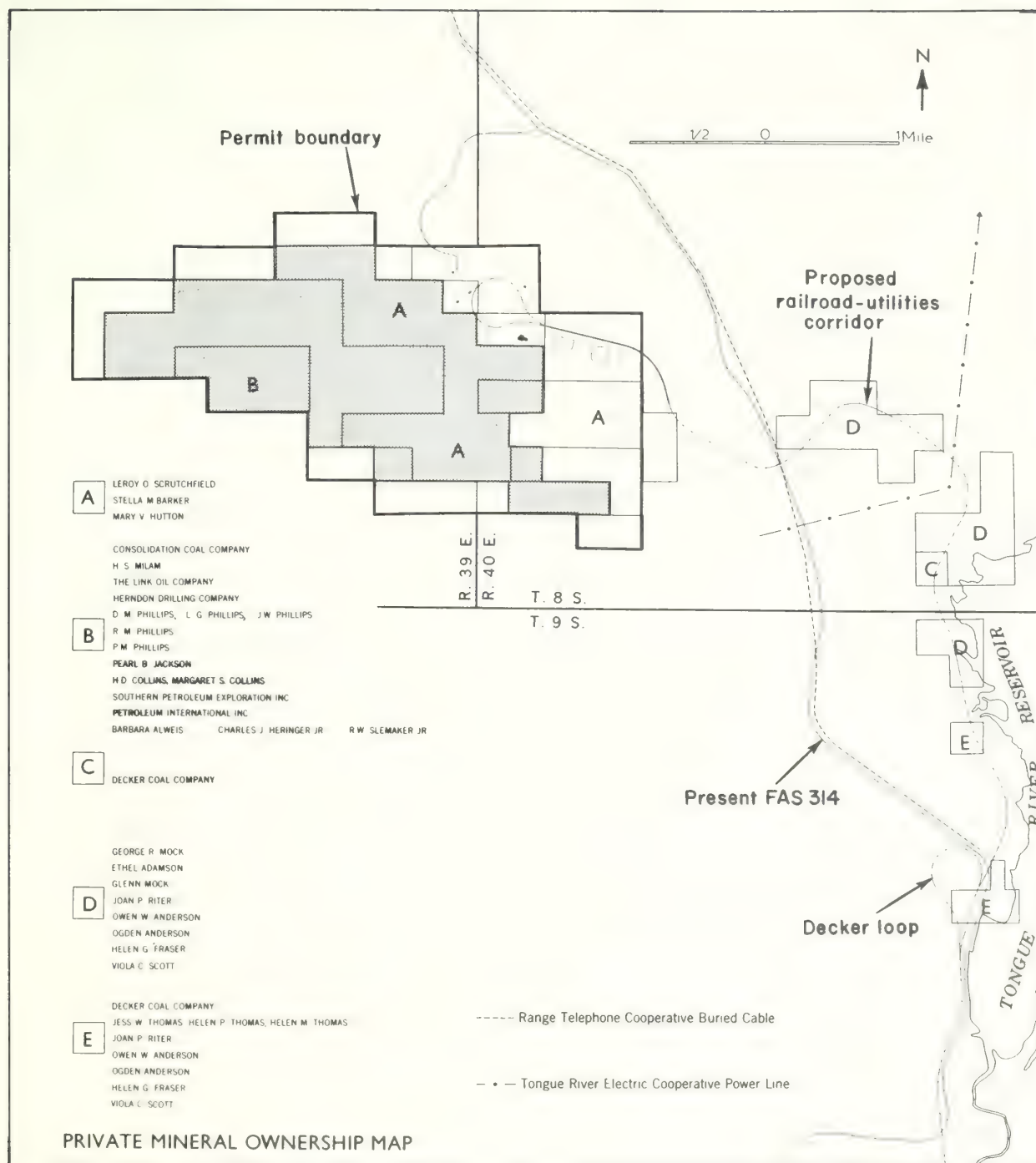


FIGURE I-5.--Map showing private non-coal minerals ownership.
(Federal coal lease Montana-069782 is shaded.)

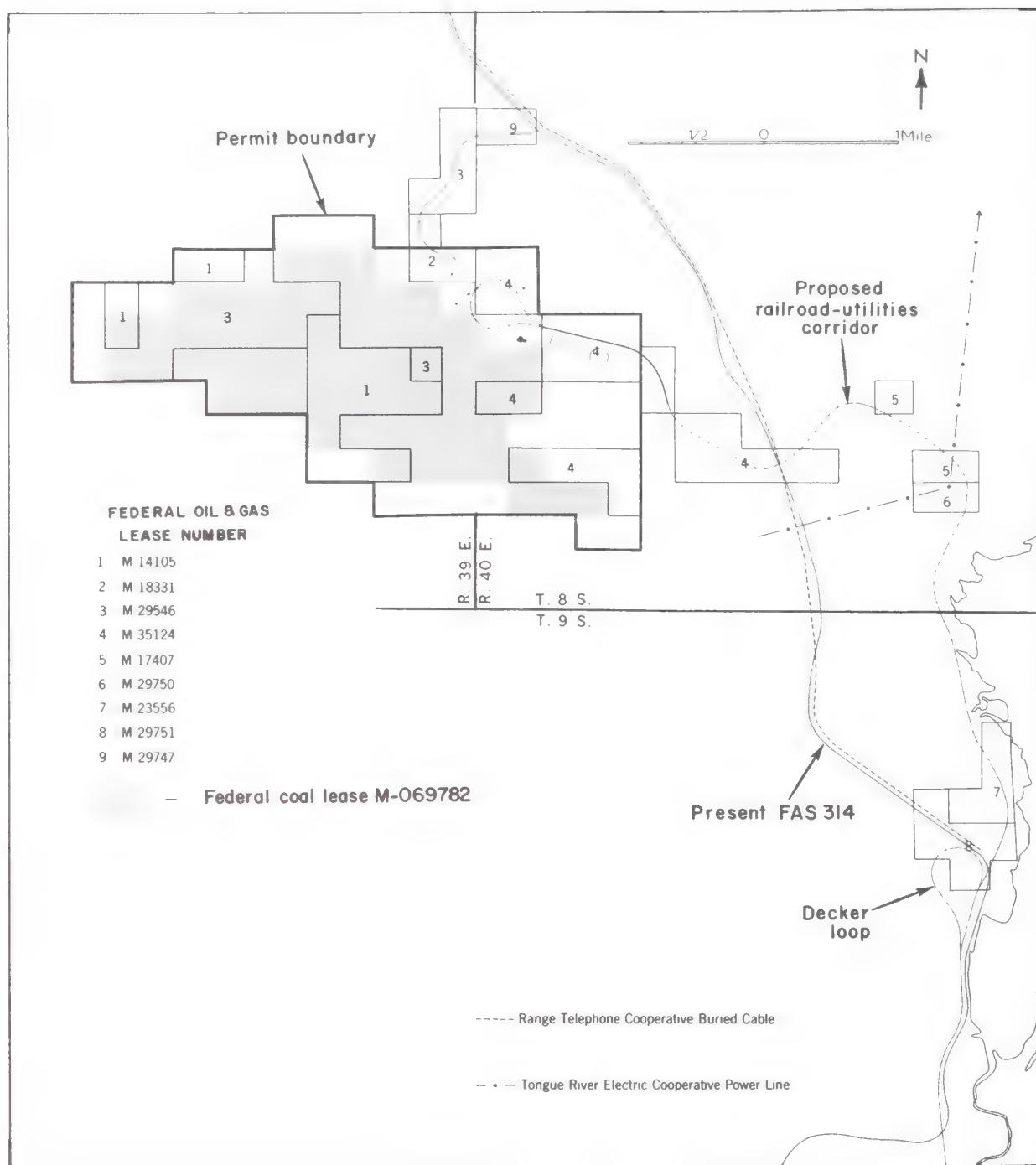


FIGURE I-6.--Federal oil and gas lease map.

Estimates based on exploration work to date indicate that about 405 million tons of reserves in the Anderson, Dietz 1, and Dietz 2 coal seams underlie lands leased by Spring Creek Coal Co. At the present time the company plans to mine only the Federal reserves. Those reserves underlying the State and private leases are considered to be uneconomical because of a greater average thickness of overburden, resulting in an unfavorable stripping ratio.¹ Also, the private lease is not contiguous with the rest of the leased area. Coal reserves are distributed among the leases as follows:

Federal lease Montana-069782-----	287 million tons
Montana State lease C-535-65-----	74 million tons
Scrutchfield lease (private)-----	<u>44 million tons</u>
 Total reserves-----	 405 million tons

Federal Lease Montana-069782, containing 2,504.22 acres, was issued to Peter Kiewit Sons' Co. on July 1, 1965, after a competitive sale. Peter Kiewit assigned this lease to Pacific Power and Light Co. (PP&L) on December 15, 1965. On September 1, 1966, the lease was modified to the present 2,346.76 acres.

The Federal lease, with the Bureau of Land Management, is a continuing lease subject to reasonable readjustment of terms on a 20-year basis. Under section 5 of the lease, the lessor may prescribe the steps to be taken and restoration to be made with respect to the leased lands and improvements thereon, whether or not owned by the United States. In addition to section 5, the lease contains four general requirements and 21 special stipulations covering surface reclamation and protection of the environment.

5. Description of the Coal Resources

The coal deposits which underlie the Spring Creek coal field are beds in the Fort Union Formation of Tertiary age. Mine plans call for exposure and extraction of three beds of coal which are essentially a single seam averaging 81 feet in thickness. The three coal beds to be mined are (in descending order) the Anderson, Dietz 1, and Dietz 2. The Dietz 1 and 2 have merged in the mine area and are separated from the Anderson seam by a parting 1 to 18 inches thick. Figure I-7 shows the coal thickness throughout the mine area.

Coal from the proposed Spring Creek mine is considered a good fuel source for electric utilities because it would meet sulfur dioxide (SO₂) emission standards of the Environmental Protection Agency (EPA). Present EPA emission standards limit SO₂ emissions from powerplants to 1.2 pounds per million Btu's fired. A comparison of relative sulfur and

¹Cubic yards of overburden to be moved, divided by the number of tons of coal to be mined.

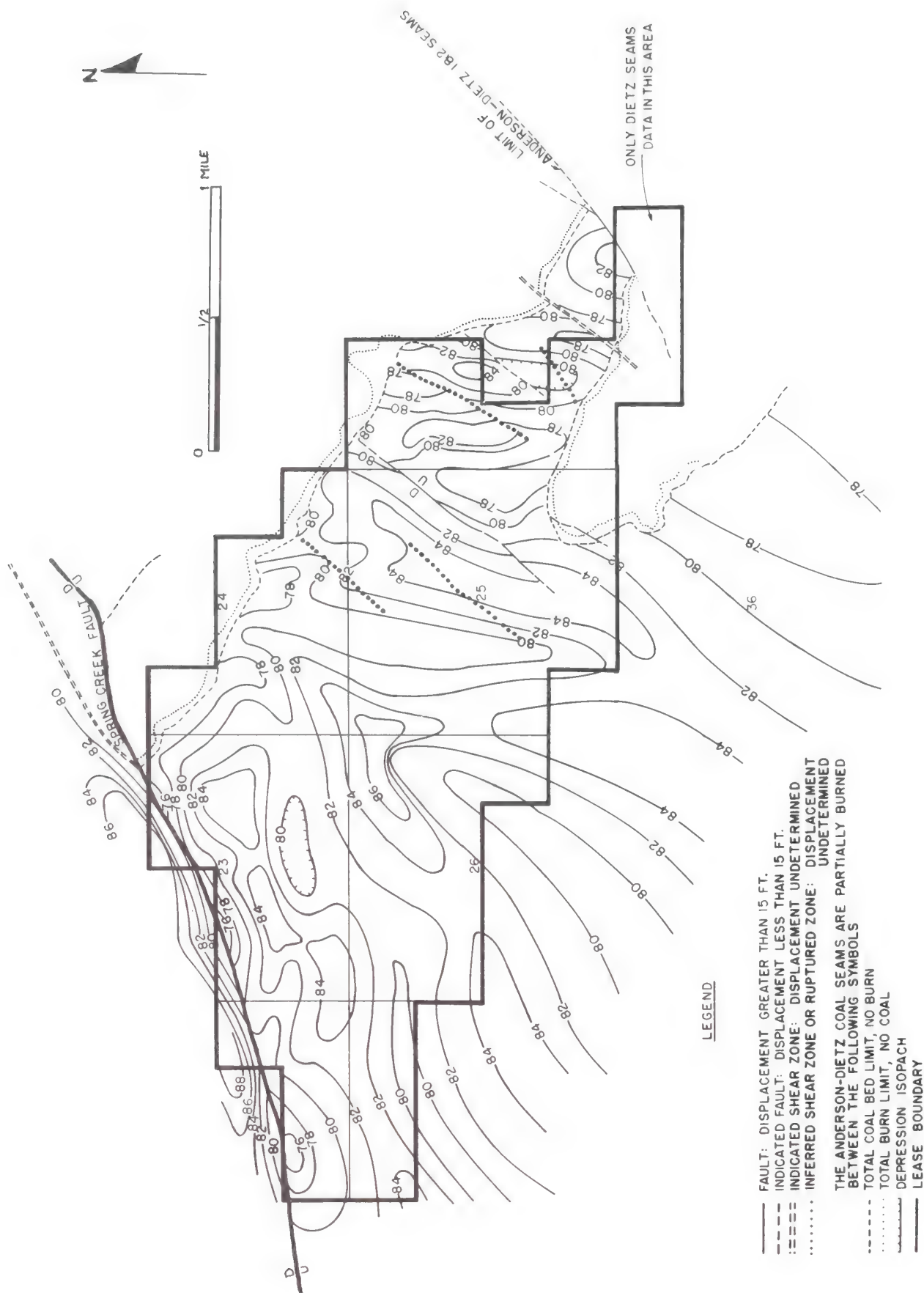


FIGURE I-7.--Isopach map of coal thickness.

heat characteristics of coal from the Spring Creek area and from Illinois is shown in the following table:

	Btu	Sulfur (percent)	SO ₂ in flue gas (lbs/million Btu)
Spring Creek ¹ -----	9,373	0.35	0.75
Illinois ² -----	11,300	2.94	5.20

¹Spring Creek average of Anderson, Dietz 1 and 2 combined seams.

²U.S. Bureau of Mines (1972).

Analyses of 17 trace elements from three test drill holes are presented in table I-2. Trace elements in water samples from the permit area do not exceed 1975 Public Health Service standards.

TABLE I-2.--Coal trace element analysis

[Analysis by Commercial Testing and Engineering Co., Denver, Colorado.
Reported from Spring Creek Coal Company permit application]

Drill hole	360		366		385	
Trace element	Geometric mean (ppm)	Range (ppm)	Geometric mean (ppm)	Range (ppm)	Geometric mean (ppm)	Range (ppm)
Copper-----	12	5-34	15	5-56	13	6-63
Lead-----	2.4	0.7-5.0	1.7	0.7-5.0	2.3	0.9-7.0
Selenium----	.5	0.3-2.0	.3	0.1-2.0	.5	0.2-2.0
Mercury-----	.07	0.02-0.31	.05	0.02-0.28	.04	0.01-0.37
Strontium---	557	150-970	393	150-980	371	80-900
Cadmium-----	1.8	0.9-4.0	1.4	0.7-2.0	1.7	0.8-4.0
Molybdenum--	3.4	0.8-13.0	2.8	0.7-13.0	7	3-42
Vanadium----	19	6-110	20	5-58	18	6-90
Cobalt-----	1.9	0.8-9.0	1.7	0.7-7.0	3.3	0.2-12.0
Manganese---	14	4-28	15	4-37	12	4-36
Arsenic-----	1.6	0.4-9.0	1.5	0.4-29	1.7	0.4-17.0
Nickel-----	6	3-30	7	3-20	6	2-15
Boron-----	16	4-37	14	4-73	8	4-20
Fluorine----	25	10-84	30	14-48	27	16-580
Chromium----	11	6-23	10	5-20	19	7-80
Zinc-----	11	2-27	16	6-36	5	2-70
Uranium-----	2	2-4	2	1-4	4	2-20

An average of 55 "as received" analyses of the coal's physical and chemical properties is as follows:

Btu/pound-----	9,407
Percent sulfur-----	.33
Percent moisture-----	24.50
Percent ash-----	3.63
Percent volatile-----	31.83
Percent fixed carbon-----	40.04
Percent carbon-----	54.64
Percent	
equilibrium moisture-----	23.40
True specific gravity-----	1.31

Another bed of coal, named the Canyon, lies approximately 106 feet below the base of the Dietz 2 seam. This bed is about 19 feet thick and is considered, by the company, uneconomical for mining because of its depth. The quality of the Canyon coal is nearly the same as the Anderson-Dietz coal, as indicated by an average of four "as received" analyses of the Canyon coal as follows:

Btu/pound-----	9,508
Percent sulfur-----	.36
Percent moisture-----	24.29
Percent ash-----	3.66
Percent volatile-----	30.64
Percent fixed carbon-----	41.47

Items of environmental concern, in considering removal of the Canyon seam, include: greater disturbance of the ground-water hydrology system; a larger amount of surface disturbance before reclamation; and, greater disturbance of the South Fork Spring Creek drainage system.

C. PROPOSALS OF THE SPRING CREEK COAL CO.

As proposed, the Spring Creek mine permit area would include all or parts of secs. 22, 23, 24, 25, 26, 27, and 36, T. 8 S., R. 39 E., and secs. 19, 20, 29, 30, 31, and 32, T. 8 S., R. 40 E. (Montana Principal Meridian) plus additional lands to be permitted for an access road and railroad/utility corridor, shown in figure I-8.

Mine development would include three distinct phases: construction of the associated facilities; mining of coal and clinker (locally called "scoria") and concurrent reclamation; and abandonment of the mine, facilities, and railroad upon the completion of mining.

1. Construction of Facilities

Upon the approval of the pending permit applications, Spring Creek Coal Co. would begin construction of coal-handling facilities, railroad

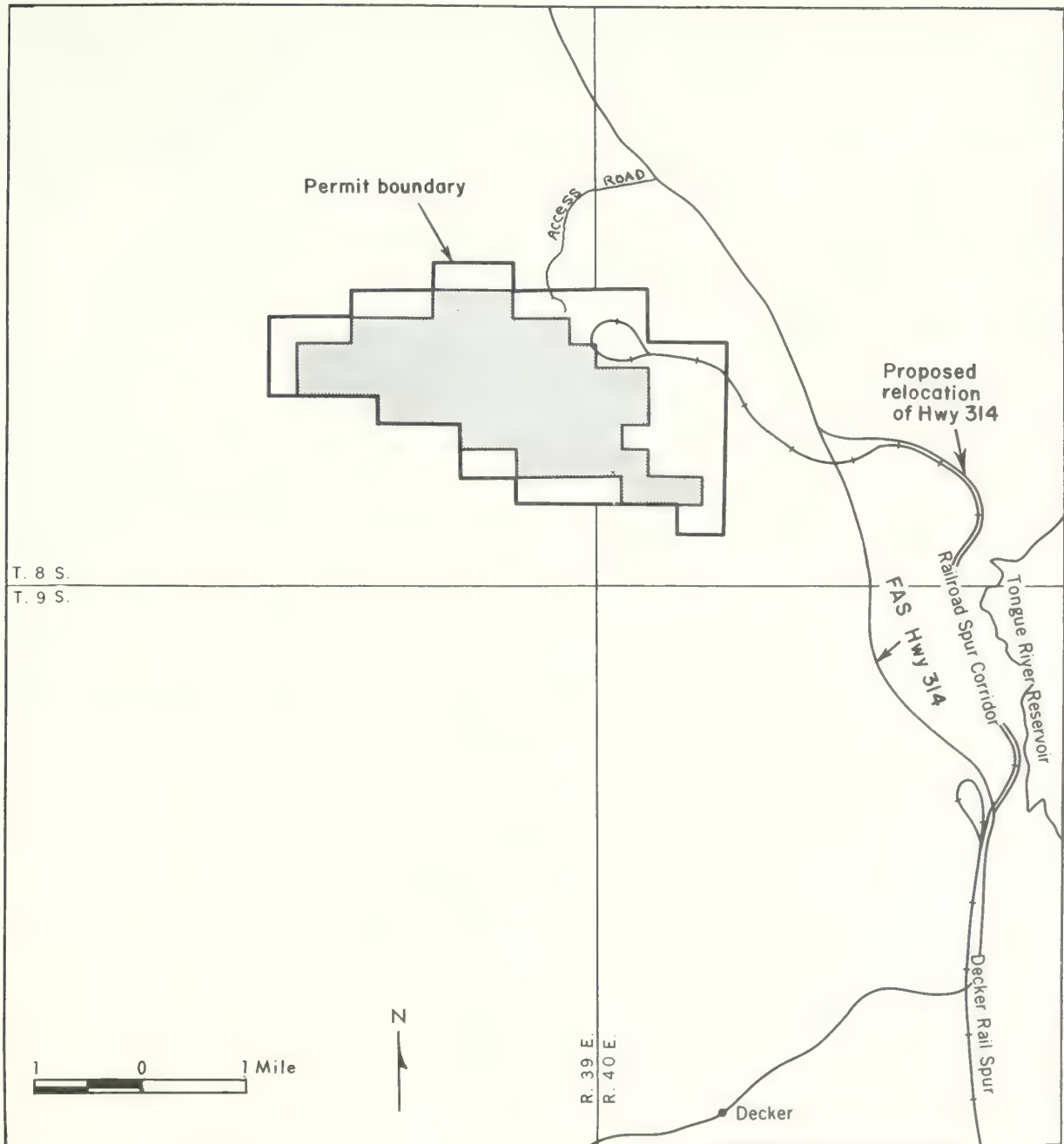


FIGURE I-8.--Map showing proposed railroad corridor, proposed route of FAS Highway 314, and proposed access road (lease area shaded).

spur and loop, access road, warehouse, administration and maintenance buildings, explosive materials storage, water pumping and waste disposal systems, stream diversions, and electric utilities. Construction activities would also include the quarrying of clinker for use as road building materials, stream diversion lining, and railroad subgrade construction material.

Approximately 897 acres would be under permit for construction activities; of this area, a smaller area would be subject to actual disturbance. Before starting construction, the company would remove topsoil from all areas to be affected, and stockpile it for use in the reclamation of those areas.

Surface coal handling and support facilities, except for portions of the access road and railroad/utility corridors, would be in part of sec. 24, T. 8 S., R. 39 E., and in parts of secs. 19, 29, and 30, T. 8 S., R. 40 E., upon surface underlain by burned or sparse, discontinuous coal. Figure I-9 shows locations of the proposed facilities.

a. Access road

Access to the Spring Creek mine would be provided by the construction of approximately 1.5 miles of roadway (fig. I-9) extending from FAS Route 314, in the NW1/4 sec. 18, T. 8 S., R. 40 E., generally southwestward along a 100-foot right-of-way to the mine office area. At present, the company has a temporary right-of-way issued by the BLM that would have to be reissued as a permanent right-of-way. All costs of road design, construction, and acquisition of right-of-way would be borne by Spring Creek Coal Co.

b. Railroad and powerline

At the present time, a railroad spur from the Burlington Northern Railroad main line near Sheridan serves the existing West Decker and East Decker mines. Construction of a 9.6-mile extension of the spur track northward to the facility location (fig. I-9) would provide rail service for the Spring Creek mine. The railroad spur would end in a broad loop that would facilitate rapid loading of coal trains. Before building the railroad, the company would have to obtain a right-of-way from the Montana Department of Natural Resources and Conservation, the BLM, and Decker Coal Co.

Culverts would be used in crossing all stream channels. The company has proposed, in conjunction with Decker Coal Company, to relocate a portion of FAS 314 to the east of the rail spur near the Tongue River Reservoir. By relocating FAS 314 to the east of the railroad and parallel to it, the need for any grade crossings or separations could be avoided. This proposal was generally discussed in the environmental impact statement, Decker mines, Big Horn County, Montana (USDI and MDSL, 1977).

A 230-kV powerline would be built along the railroad corridor to the mine facility site where a substation would be built. Incoming

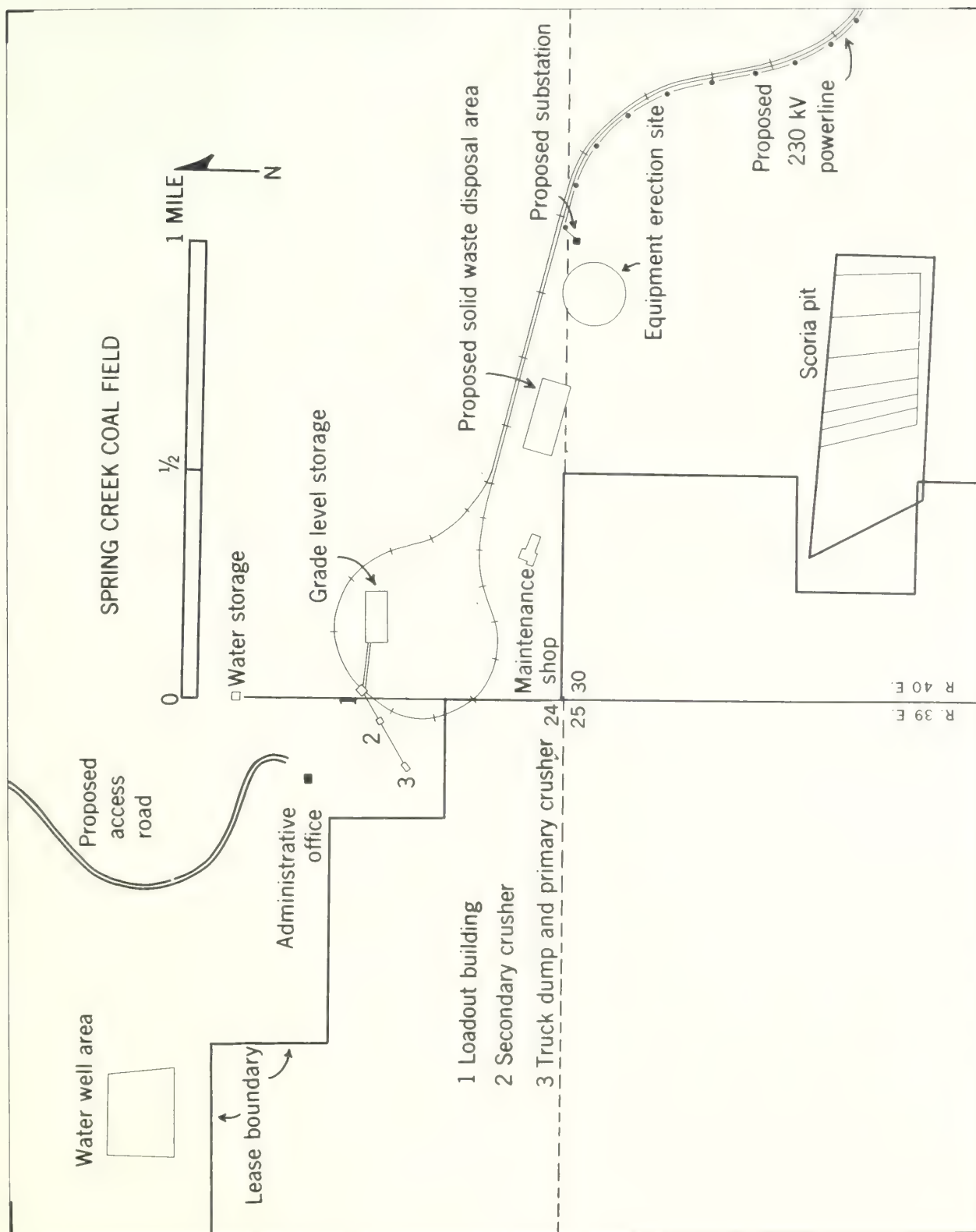


FIGURE I-9.--Map showing mine facilities for the Spring Creek mine.

power to the mine would be transformed down to 7,200 V to provide power for the major mine equipment (dragline, drills, and shovels), and would be further reduced to 440/220/110 V to supply the coal-handling and miscellaneous facilities. The company has designed the powerline to avoid unnecessary impacts to eagles and other raptors.

Electrical powerlines within the coal-handling facility would be buried, and armored cable would distribute power to secondary transformers located throughout the area. From the primary substation, power would be carried by overhead lines to portable substations from which insulated trailing cables laid on the ground would carry power to the in-pit equipment. The electric shovels, dragline, and the coal-handling facility would be the major consumers of power at the mine. The connected load of the three shovels would be about 3,180 kW (demand load), and that of the coal facility about 5,970 kW (demand load). The dragline and overburden drill would use about 3,710 and 371 kW (demand load), respectively.

c. Structures

Mine facilities consisting of offices, maintenance shops, warehouse, change room, and bath facilities would be housed in steelframe buildings.

d. Fuel and Explosive Storage

Diesel fuel, for equipment and use with ammonium nitrate prills (beadlike pellets), would be stored in above-ground tanks and gasoline would be stored in underground tanks in the vicinity of the maintenance shop. Two fuel islands, one for each type of fuel, would be constructed. Estimated annual fuel consumption would be 32,000 gallons of gasoline and 2.25 million gallons of diesel fuel.

Explosives for use at the mine would be stored as follows: class A (blasting caps, recast primers, and primacord) would be stored in a powder magazine; class B (water gels and sensitized prills) would be stored in approved drop trailers; and class C (bulk prills) would be kept in storage silos, well removed from fuel storage areas. Although separate, these facilities would be adjacent to one another. Storage areas for blasting materials would be located in accordance with applicable Federal regulations (30 CFR 715.19).

Ammonium nitrate prills are not classified as explosives until a sensitizing agent, such as fuel oil, is added. Spring Creek Coal Co. estimates an annual consumption of 6.4 million pounds of prills and 1.1 million pounds of water gels.

e. Coal processing and storage facilities

Coal transported from the pit area by end-dump trucks of 120- to 170-ton capacity would be unloaded at the truck dump where a gravity feed would lead to the primary crushers. Primary crushers would reduce the coal to a maximum diameter of 9 inches. An elevated conveyor would

transport the coal to a second crusher which would reduce the coal to a size no greater than 2 inches in diameter. A second conveyor would then transport the crushed coal to the loadout facilities. Under normal conditions, coal would be transferred from the loadout by conveyor to the storage facility. The storage facility would consist of an enclosed travelling stacker and drum reclaimer located at grade. Coal would next be transferred from the storage facility by conveyor to the loadout building where it would be sampled, weighed, and loaded into rail cars. In an emergency, coal could be loaded directly into rail cars by conveyor from the secondary crusher.

f. Water supplies and waste disposal

Major industrial water use would include dust suppression for haul roads, coal-handling facilities, and the shop area; equipment washing; and fire control. Water for haul-road dust suppression would average 67,000 gallons per day (gpd) and would be obtained from ground water inflow to the mine pits. Water for dust suppression in the coal-handling facilities is estimated to average 124,000 gpd. Additional water would be required for employee needs (about 6,500 gpd assuming 25 gpd per person). The additional water needs would be supplied by deep water wells yeilding up to 150 gpm from the Fort Union Formation (fig. I-9). Water from the wells would be stored in two water tanks having a combined capacity of 800,000 gallons (fig. I-9). Water for dust suppression not available from ground-water inflow into the pit area would be obtained from storage tanks.

Sewage disposal facilities would include three leach fields, the largest of which would be designed to accomodate waste generated by 250 people. A solid refuse disposal area would be used for noncombustible solid wastes. Permits for waste disposal are outlined in table I-1.

g. Haul roads

All haul roads would be about 100 feet in width and would be surfaced with crushed clinker (scoria) from the mine and scoria quarry area. Roads constructed for the purpose of hauling coal and overburden, and the general-purpose roads in and around the mine, would be designed and built by mine personnel with mine equipment. All roads would be constructed to drain adequately according to Federal and State agency guidelines. Haul roads would not be blacktopped but would be sprinkled regularly with water for dust suppression.

Haul roads would be maintained on grades of at least 7 percent out of the pit in order to minimize their lengths through the spoil areas, and thus allow for a minimum amount of disturbed land at any one time. No more than two ramp roads per mile would emerge from the pits to the surface.

h. Water diversion and impoundment

Two ephemeral streams, Spring Creek and South Fork Spring Creek, would be disrupted by the mine. South Fork Spring Creek, which flows from northwest to southeast across the southern part of the permit area, has the greatest length exposed to mining level disturbance, but has a smaller drainage area than Spring Creek. Spring Creek, to the north of South Fork and flowing in a parallel direction, crosses the permit area's northeast edge.

Both Spring Creek and South Fork would require diversion if the mine plan is permitted. Alteration of these stream channels may require some consultation with the Fish and Wildlife Service under the Fish and Wildlife Coordination Act. Two diversions of South Fork would take place during years 1 and 9 of the mining operation and would involve 14,800 and 7,800 feet of the stream channel, respectively. Spring Creek would also be diverted in two steps. Preceding mining, 8,200 feet of Spring Creek would be diverted to the north of the mining area; in year 9, an additional 2,600 feet would be diverted. Figure I-10 shows both the location and the timing of the proposed stream diversions.

According to the company's calculations based on the Precipitation-Frequency Atlas of the Western United States (USDC, 1973), engineered channels for the diversions would be capable of passing a 50-year peak flow with freeboard. This flow would be expected from a storm with a duration of 6 hours and a precipitation of 2.2 inches. The channels would have a bottom width of 14 feet with side slopes of 2:1. Where the channels would be excavated in easily erodible material, the sides and bottom would be lined with a 1-foot-thick layer of clinker (fig. I-11).

Approximately 10,000 feet of the relocated channel of Spring Creek would have a minimum depth of 7.5 feet and would pass a 50-year peak flow with about three-fourths of a foot of freeboard. The final 800 feet of relocated channel would be excavated in clinker to form cascades and rapids to dissipate the energy of the water prior to reentering the existing Spring Creek channel.

About 22,100 feet of the relocated channel of South Fork would be constructed to a minimum depth of 6.5 feet. This channel would pass the 50-year peak flow with a minimum of about one-half of a foot of freeboard. To maintain the slope of the channel at 0.0075 (about $1/2^\circ$), a series of drop structures would be constructed. The drop structures would consist of 3-foot high gabions of steel wiremesh baskets filled with clinker. The final 500 feet of the relocated channel would be excavated in clinker to form cascades and rapids to dissipate the energy of the water prior to reentering the existing South Fork Spring Creek channel.

The mine plan would ensure that the diversion channels approximate the existing channel characteristics of Spring Creek and South Fork. Although their gradients would be somewhat greater, the new channels would be lined with clinker, to increase the coefficient of friction,

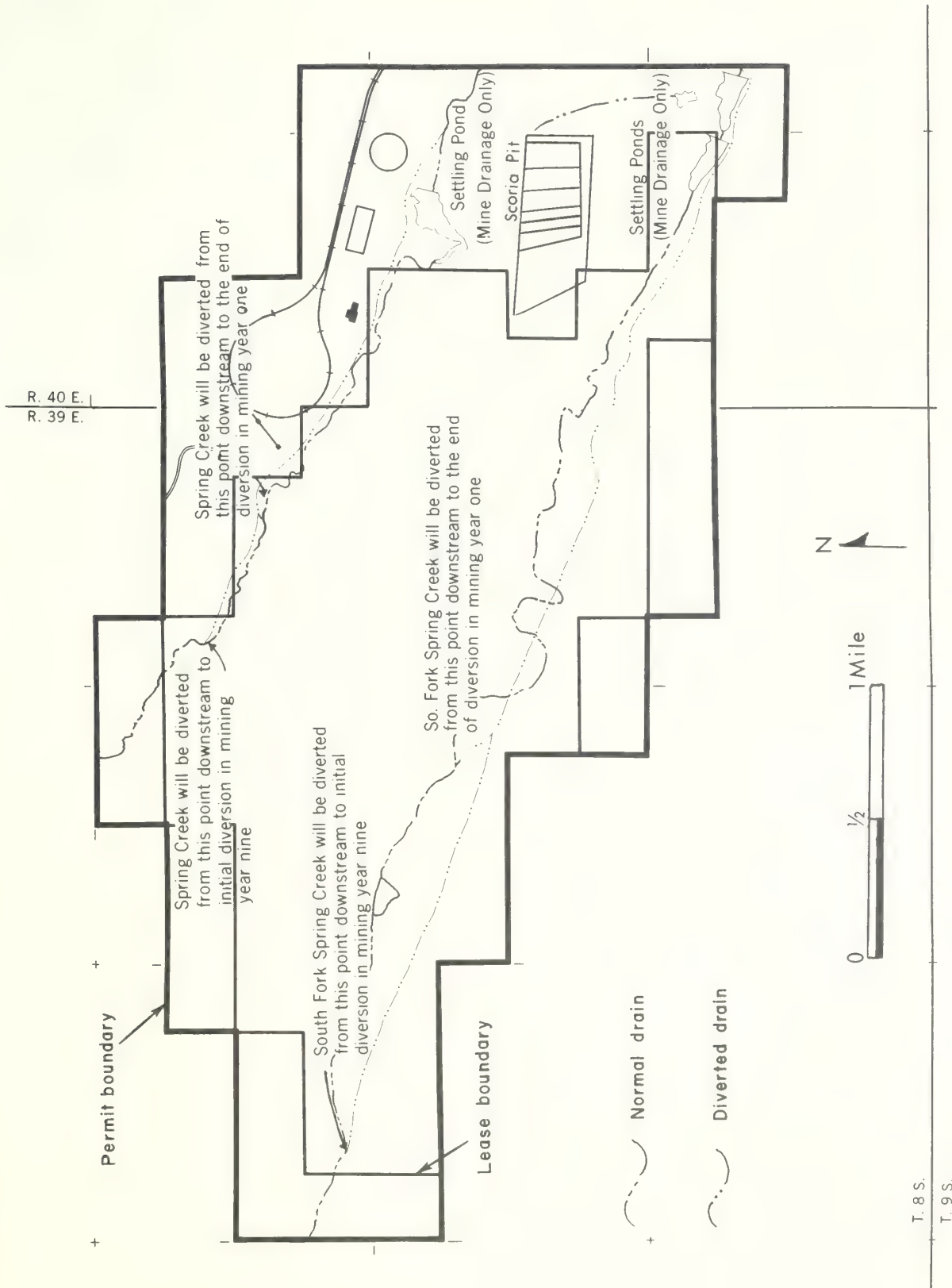
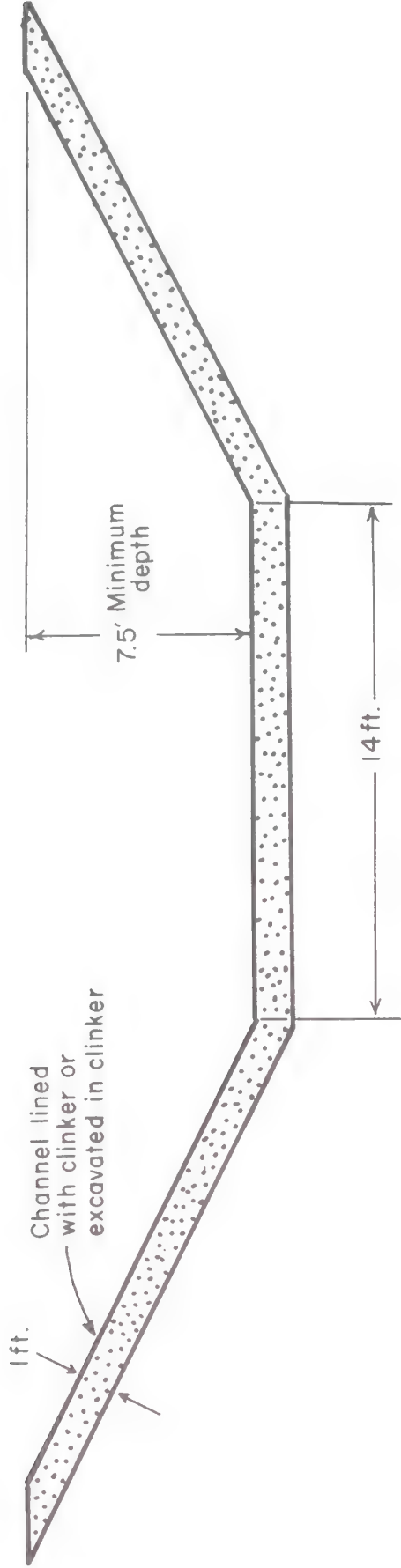


FIGURE I-10.--Map showing drainage plan.

SPRING CREEK DIVERSION CHANNEL



NOTE : South Fork Spring Creek diversion channel is dimensionally identical to Spring Creek with the exception of the channel depth which is 6.5' minimum depth on South Fork

SCORIA PIT DIVERSION DITCH

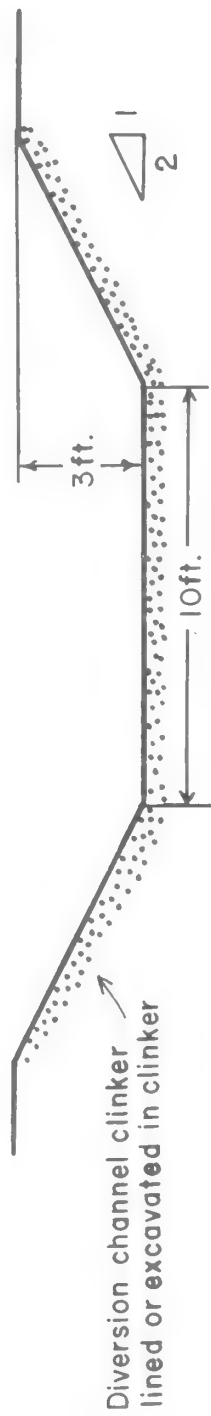


FIGURE I-11.--Diagrams showing diversion channel construction.

and would have drop structures built into them. Those features would reduce the erosion potential of the steeper channels.

At no time would runoff from either of the stream channels be allowed to drain into the mine area. To protect the mine from excess water during periods of heavy precipitation and runoff, the company proposes to establish perimeter ditches around the high sides of the active mine pits, in addition to diverting the two creeks away from the mining operations.

Runoff from the mine area as well as that from the scoria pit would be collected in settling impoundments (fig. I-10). Also, water not needed for dust suppression would be collected in the active pits and pumped into the impoundments. All impoundment dams would be earthfill structures consisting of compacted impervious cores and compacted random fill upstream and downstream shells (fig. I-12).

The runoff from the Spring Creek drainage would be collected in a 90-acre-foot impoundment, while runoff from South Fork would be collected in two impoundments of 34- and 64-acre-feet, respectively. Runoff from the scoria pit would be diverted towards South Fork in a diversion ditch having a slope of 0.01 (about $1/2^\circ$) (fig. I-11). This runoff would be collected in an impoundment having a capacity of 14 acre-feet.

All diversion ditch banks and impoundment dam banks would be sown with a vegetative cover to reduce erosion of both the banks and the structures.

2. Mining and Reclamation

Overburden removal would start approximately 6 months before the completion of construction. State and Federal laws dictate that mining plans can be approved for a period of only 5 years at any one time. At the end of 5 years, Spring Creek Coal Co. would have to obtain another 5-year permit to continue mining in accordance with its proposal. For this reason, the life of the mine will be addressed, and those proposals which would be covered by the 5-year permits emphasized.

The company proposes to mine approximately 40 million tons of coal in the first 5 years of production, beginning in 1980. The first year's production would be about 3 million tons; the second year, 7 million; and every year thereafter, 10 million tons.

The company proposes to open the mine using conventional stripping and mining equipment. During the first 2 years of the operation, two initial box cuts would be opened (fig. I-13). The first box cut would start in the northeastern corner of the property (NW1/4 sec. 30, T. 8 S., R. 39 E.) and proceed northwestward. Upon completion of overburden removal from the first cut, the dragline would be "walked" to the western end of the second box cut (SE1/4 sec. 22, T. 8 S., R. 39 E.). Overburden removal in the second cut would progress to the southeast. Successive

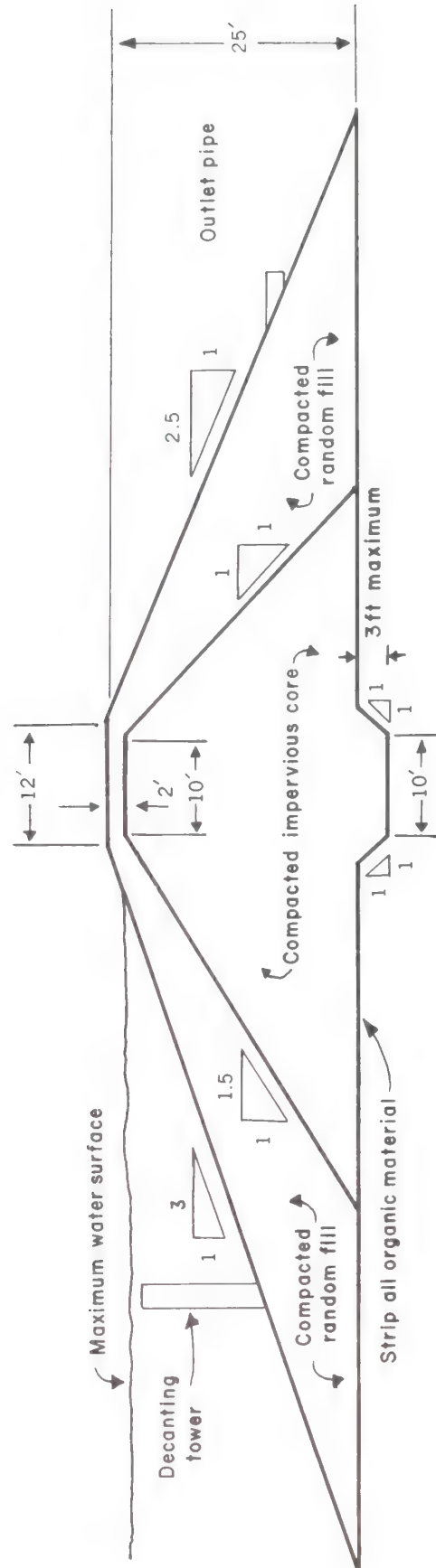


FIGURE I-12.--Cross section showing typical dam construction.

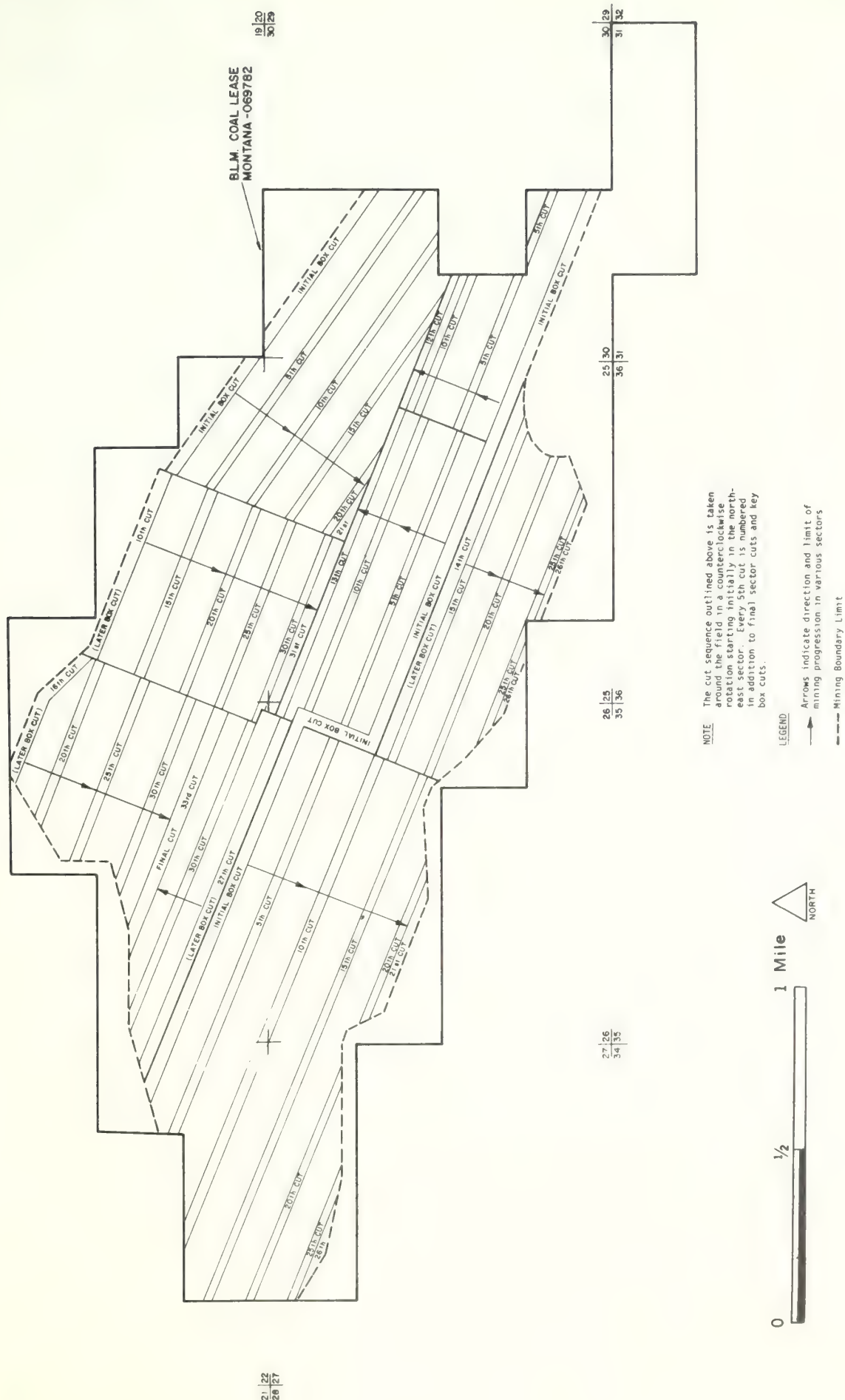


FIGURE I-13.--Map showing the proposed progression of mining within Federal coal lease Montana-069782.

cuts would parallel the first two cuts and progress in a counterclockwise direction. Upon completion of the first two box cuts, essentially three pits would be formed. These would result from the first box cut and the eastern and western parts of the second box cut.

Spoil material from the first box cut would be cast to the north of the pit on unmined land clear of all vegetation and topsoil material (fig. I-14). This spoil material would later be replaced in the initial box cut. The spoil material from the second box cut would be cast to the north, along the western half of the pit, and to the south along the eastern half. Orientation of the pits according to the mining sequence would allow for the equalization of the stripping ratio. In each successive pass, the overburden would be placed in the previously mined-out cut. This cycle would be repeated for the 25-year life of the mine. At the final cut, a highwall would form the upslope side of the pit. As proposed by the company, the final highwall would be reduced by grading the upslope material into the final pit at a slope of 36 percent (20°), within the requirements of 30 CFR 715.14(a)(2). Figure I-15 shows a typical method of highwall reduction.

Concurrent with the mining of coal would be the quarrying of clinker. This material would be obtained from the bluffs to the east of the mine area and from the clinker caps of the bluffs within the coal lease boundary (fig. I-14). Present plans call for private contractors to quarry and crush the clinker for use as a topping material on haul roads and auxillary roads. The quarrying would take place during the 3 summer months of each year; the crushed clinker would be stockpiled for later use.

The mining application proposes to permit a total of 4,420 acres (fig. I-16). During the first 5 years approximately 312 acres would be disturbed by coal mining; 757 acres by other mining level disturbance, including 20 to 30 acres for clinker excavation; 897 acres for facilities disturbance (a smaller area will be subject to actual disturbance); 2,293 acres for associated disturbance; and 161 acres for a buffer zone around the disturbed area. It is anticipated that mining would disturb approximately 70-100 acres per year. At the end of the 25-year life of the mine, coal would be removed from about 1,850 acres and clinker from about 95 acres.

a. Soil material removal and storage

Beginning with the earliest construction activities and continuing through the life of the mine, topsoil would be removed from all areas affected by construction, removal of overburden, or placement of spoils. All available topsoil would be removed in advance of mining by self-loading and/or conventional rubber-tired scrapers. The topsoil and other material of seedbed quality would then be hauled either to predetermined stockpile locations (fig. I-14) or redistributed directly on the graded spoils. In addition to topsoil, material would be salvaged from depths below the "A" horizon if it were at least the seedbed quality of material presently on the surface.

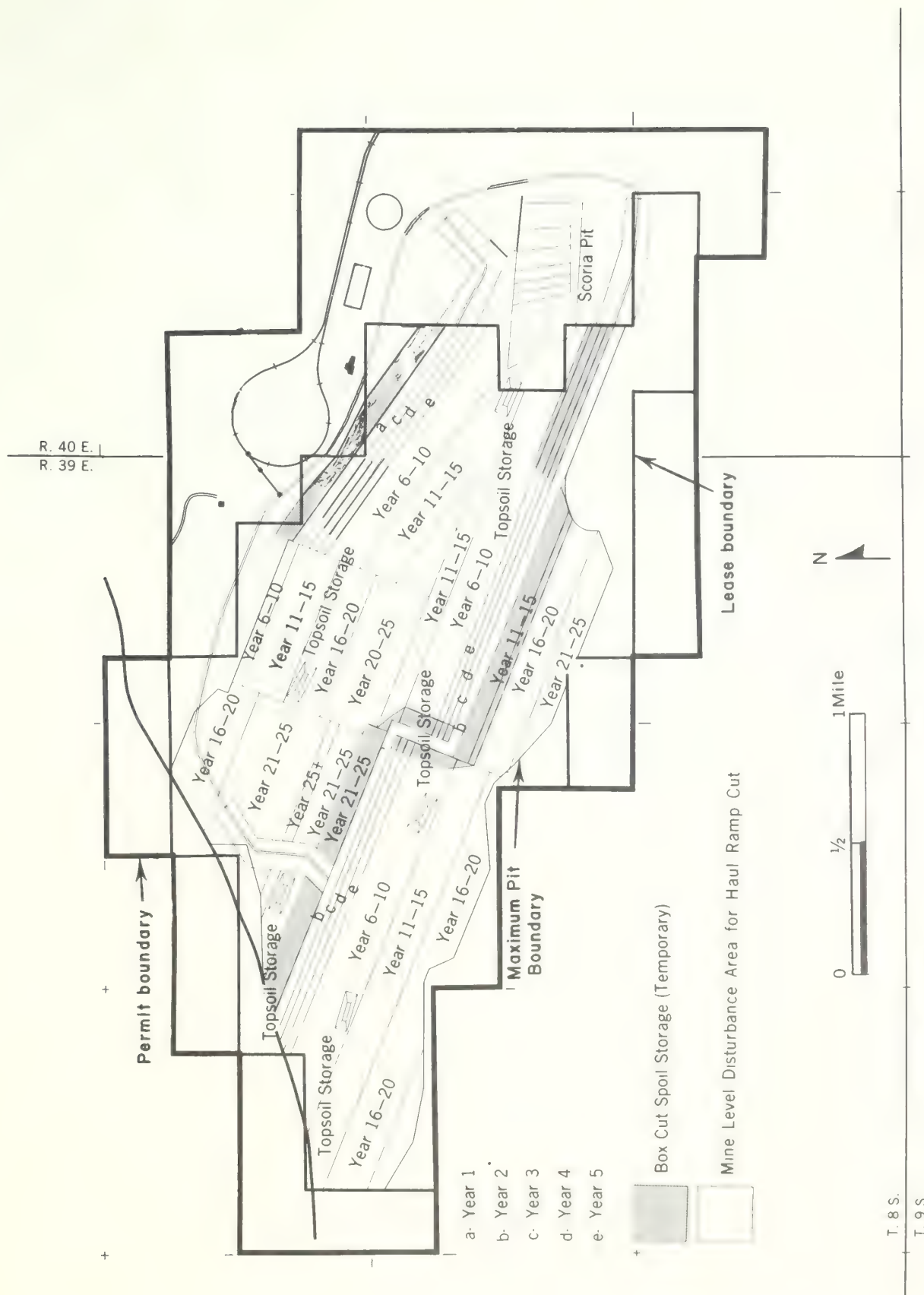
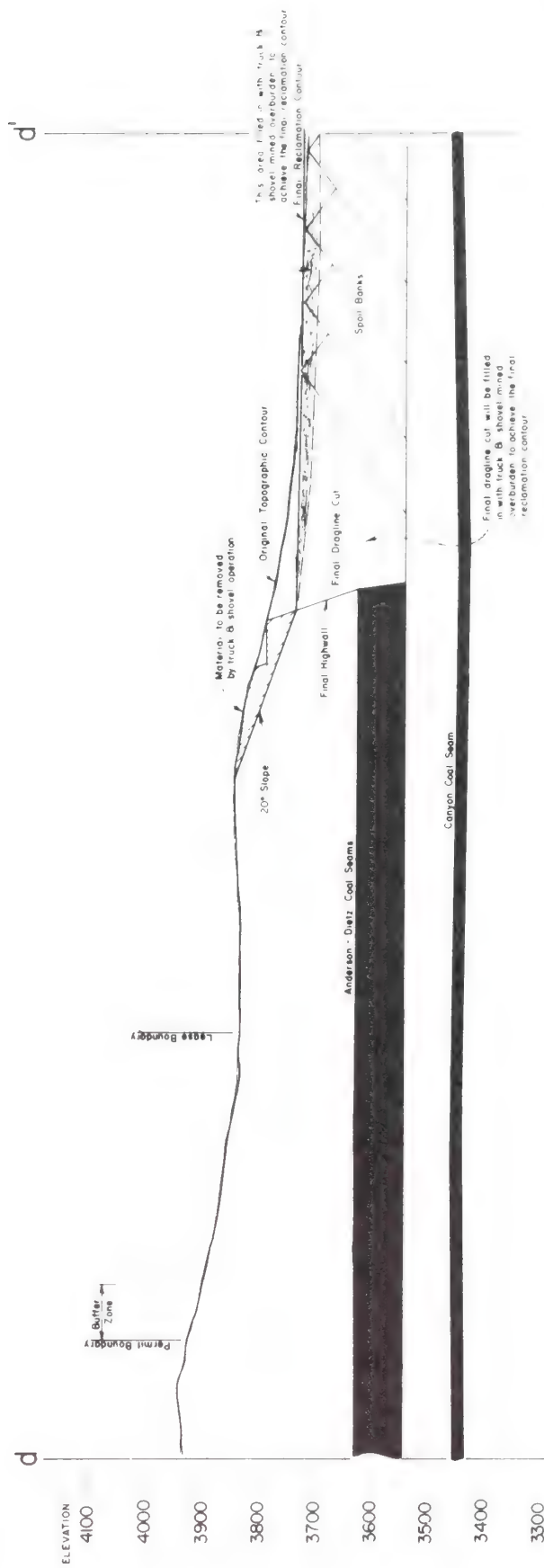
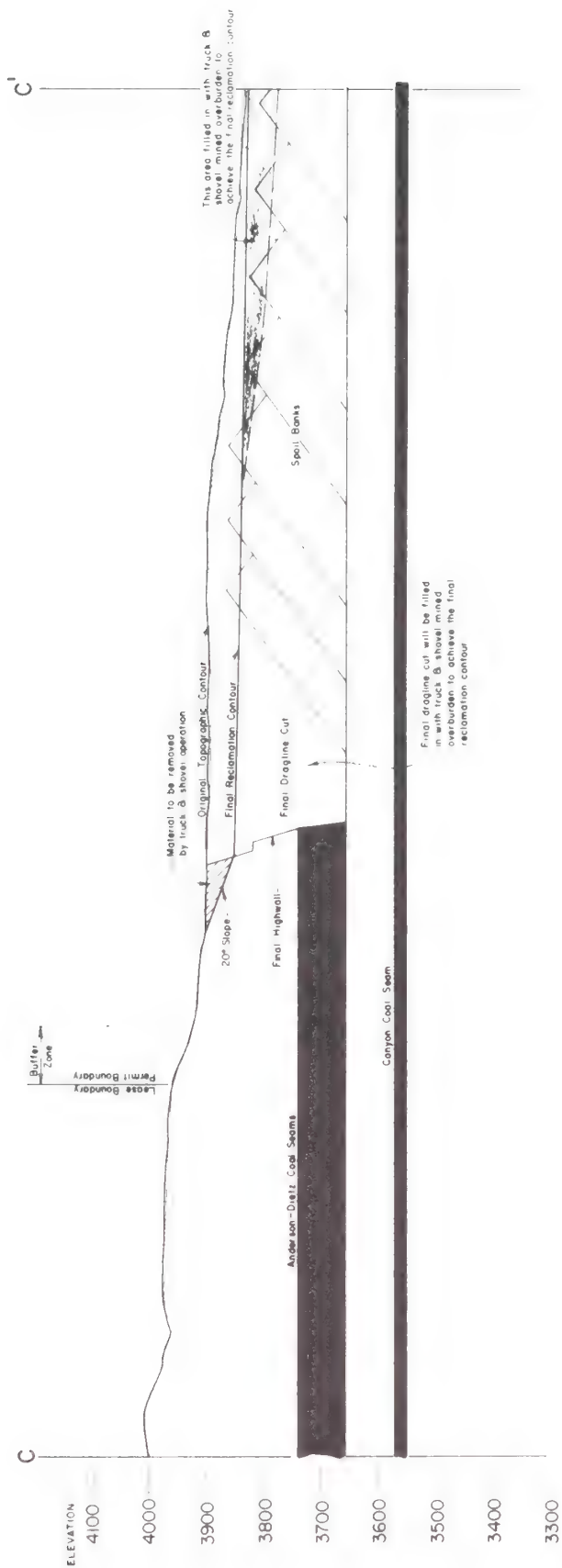
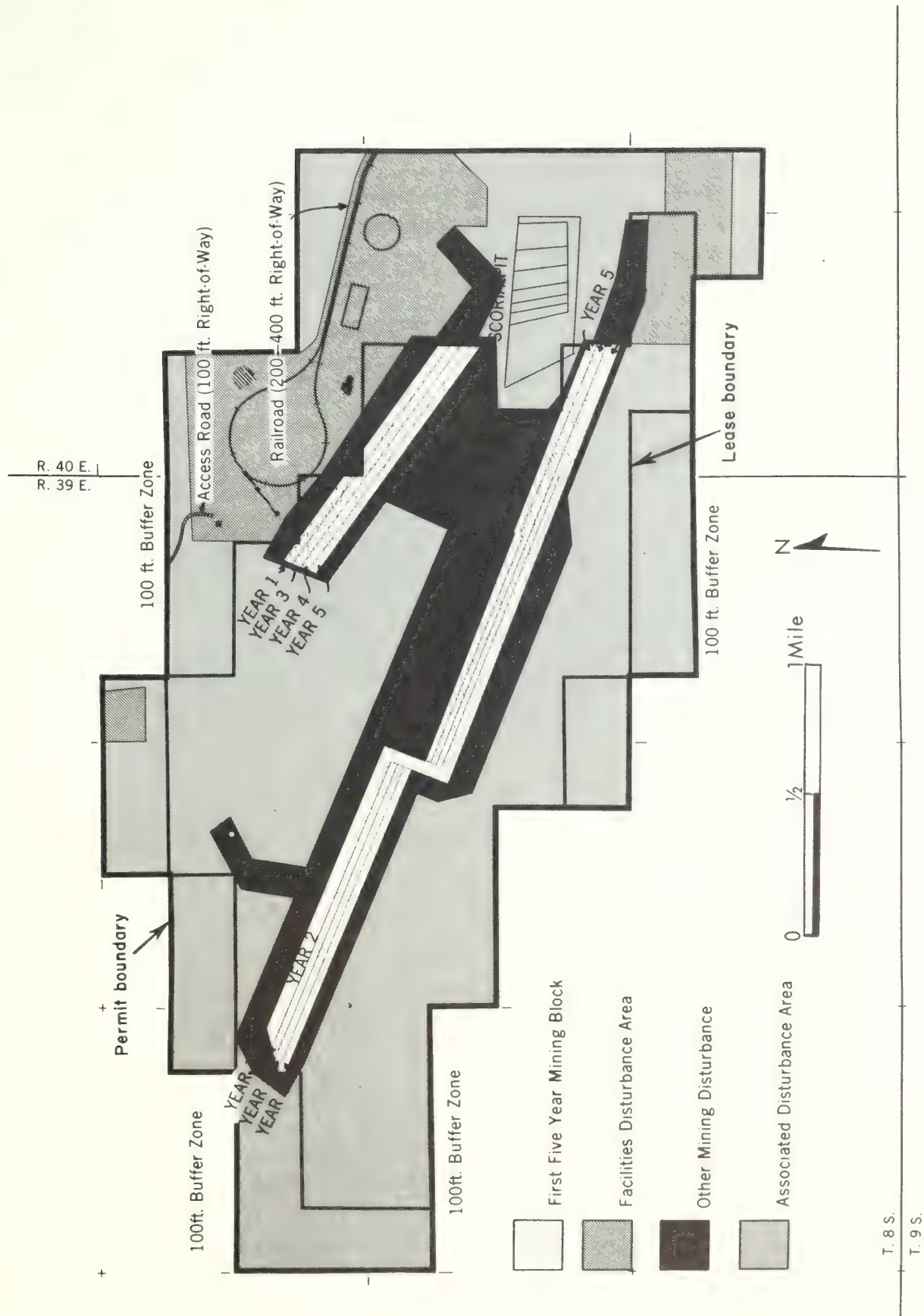


FIGURE I-14.--Map showing the progression of mining by year and locations of overburden and topsoil storage.



NOTE:
Both sections show northwest
of the southern bluff highwall reduction

FIGURE I-15.--Cross section of highwall reduction.
(See figure I-19 for location.)



Topsoil stripping and replacement would be an integral part of mining and reclamation. After sufficient areas have been mined, back-filled, and recontoured, topsoil removed in advance of mining would be transported and placed on the recontoured spoils in a single operation, avoiding insofar as possible the need to stockpile.

When topsoil is not to be replaced on a backfilled area within a period of time when such soil might deteriorate, the company proposes to establish and maintain an approved cover of quick-growing vegetation or use other approved protection measures in accordance with State and Federal regulations. Such measures would protect the soil from erosion, discourage the establishment of noxious plant species, and maintain the soil in a condition suitable for sustaining vegetation when used in reclamation.

b. Overburden removal

After the topsoil has been removed, areas requiring overburden stripping would be drilled and blasted using ammonium nitrate-fuel oil mixture (ANFO). The amount of explosive placed in each hole would depend on the characteristics and configuration of strata to be blasted and the spacing of the adjacent holes.

High-explosive primers would be detonated by primacord and would themselves initiate prill detonation in each blast hole. Blasting would be scheduled for day shifts only, 5 days a week. Blasting procedures would be in keeping with all safety regulations. The company currently estimates that 5-6 explosive charges per week would be detonated.

Because of the variable thickness of overburden, the method of overburden removal would also vary (fig. I-17). A two-step system of stripping, using a large mining shovel and truck fleet, is planned where overburden thickness exceeds 120 feet.

Trucks of 120- to 170-ton capacity would move overburden to areas requiring fill material to achieve reclamation goals. A walking dragline (52 yd³) would then remove the overburden below the 120-foot cover line and deposit it in a previously mined pit. Where the overburden was less than 120 feet thick, the first step of shovel and truck removal would not be necessary.

The company anticipates that blasting, loading, and dumping would cause overburden to expand in volume by about 25 percent. However, some compaction (possibly as much as 5 percent) would result from the movement of heavy equipment during regrading and the replacement of topsoil.

c. Coal drilling, blasting, and removal

Drilling and blasting would be used to break up the coal seam: blasting procedures would be similar to those used to break up the overburden. Large power shovels (one in each active pit), equipped with coal

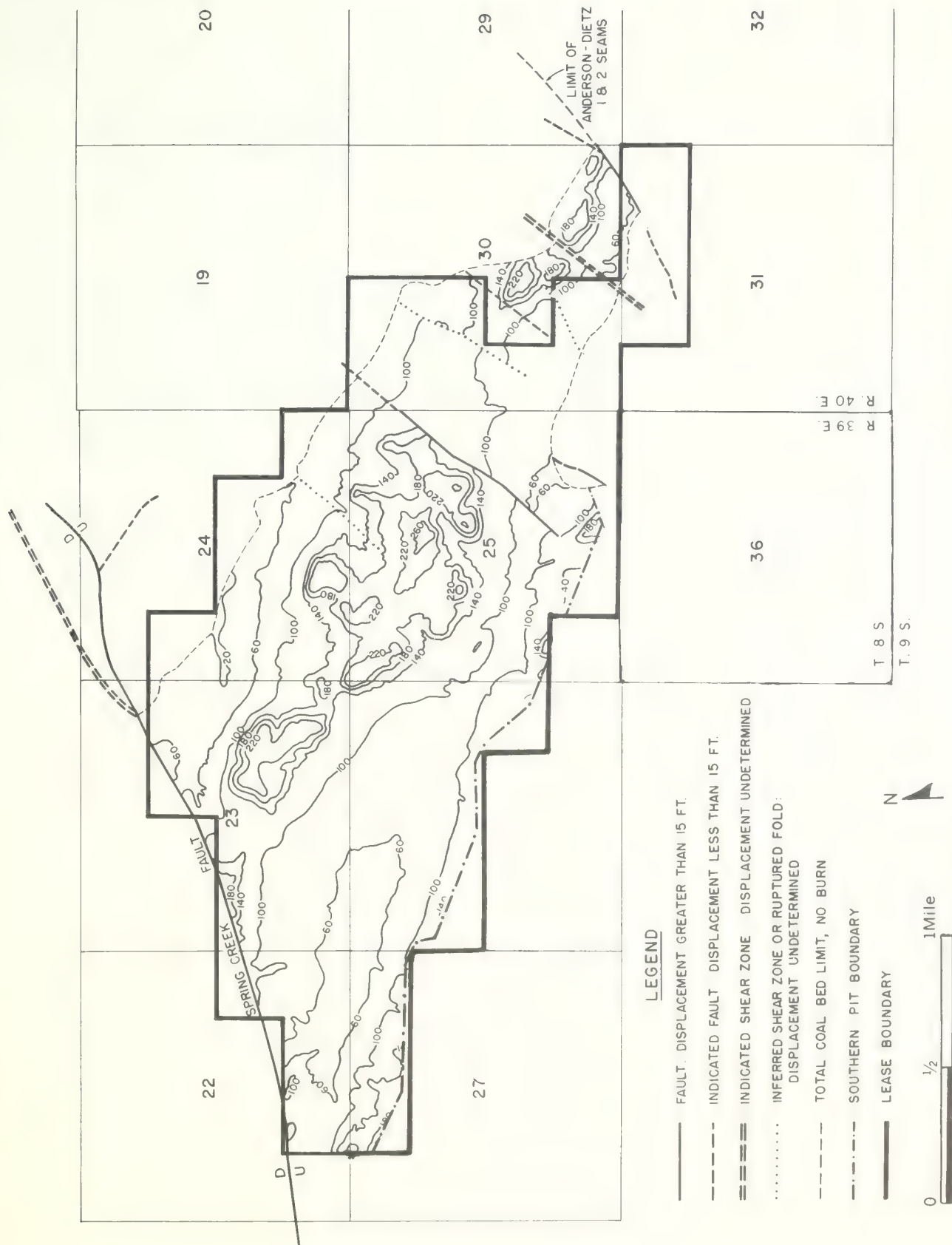


FIGURE I-17.--Isopach map showing overburden thickness.

dippers of approximately 25-30 yd³ capacity, would load the coal into trucks (120- to 170-ton capacity) for transport to the coal handling facilities.

d. Reclamation

In accordance with State and Federal laws, Spring Creek Coal Company proposes to reclaim all mined and associated-disturbance areas to meet the required standards should the mining and reclamation plan be approved by the appropriate regulatory agencies.

1) Spoil reclamation

Reclamation of disturbed land, resulting from stripping and mining, would lag by one or two rows of spoil behind each operating dragline pit, to facilitate proper "cut and fill" techniques on the piles. Figure I-18 shows those areas to which supplemental material would be transported. The spoil material would be leveled to the required contours. Except for the highwalls, which would have 20° slopes (36 percent), the maximum slopes permitted after reclamation would be about 11° (20 percent). The proposed final topography for the reclaimed area is shown in figure I-19.

As encountered, thin unminable coal seams and other materials unsuitable for revegetation must (under State law) be buried to a minimum depth of 8 feet below the reclaimed surface. Immediately prior to topsoil replacement, the spoil surface would be ripped or disced to provide a more natural interface between the regraded spoils and redistributed topsoil and to enhance stabilization of reclaimed areas.

2) Topsoil redistribution

Topsoil to be placed on regraded spoil surfaces would be obtained from either topsoil stockpiles or directly from areas where topsoil is being removed in preparation for mining. As indicated on page I-31, topsoil would be replaced directly on spoil surfaces without stockpiling, insofar as possible. The company anticipates that approximately 2 feet of topsoil would be spread over reclaimed surfaces except along the flood plains of the stream channels, where 4 feet of topsoil would be placed.

Topsoil amendments in the form of annual cover crops, mulching, and fertilizer have been proposed by the company, which must meet statutory requirements. An annual cover crop, such as millet, would be sown on areas receiving a direct placement of topsoil to provide a protective cover during the establishment of a permanent, diverse vegetation cover. On areas where the topsoil is from a topsoil stockpile, a straw or hay mulch would be applied at a rate of 2 tons per acre and crimped or disced into the topsoil prior to seeding. The application of fertilizer would be based on the results of soil tests conducted after topsoiling operations were completed. Required fertilizer amendments would normally be applied during the second growing season following vegetation establishment.

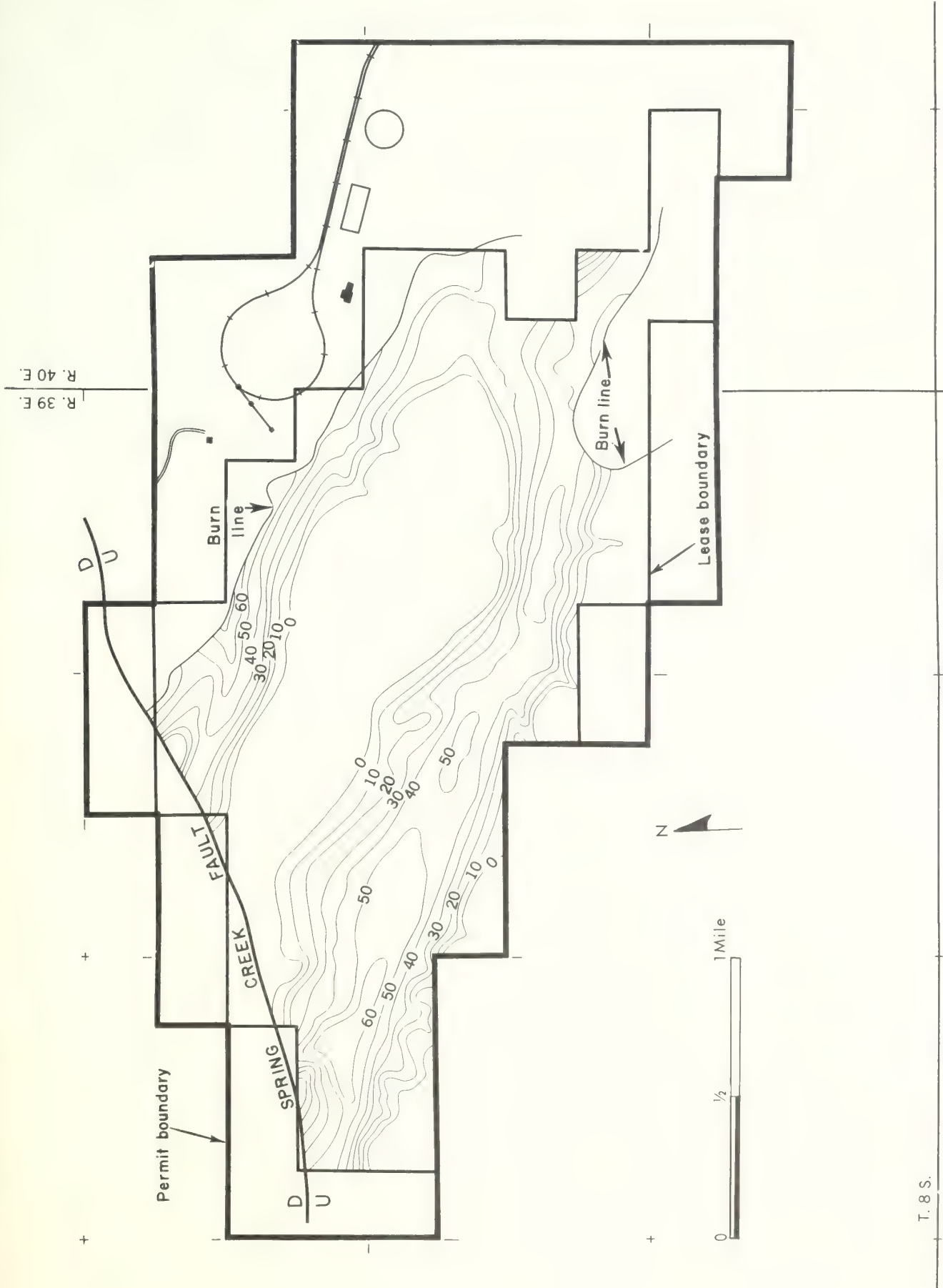


FIGURE I-18.--Fill area isopachs for truck and shovel stripping.

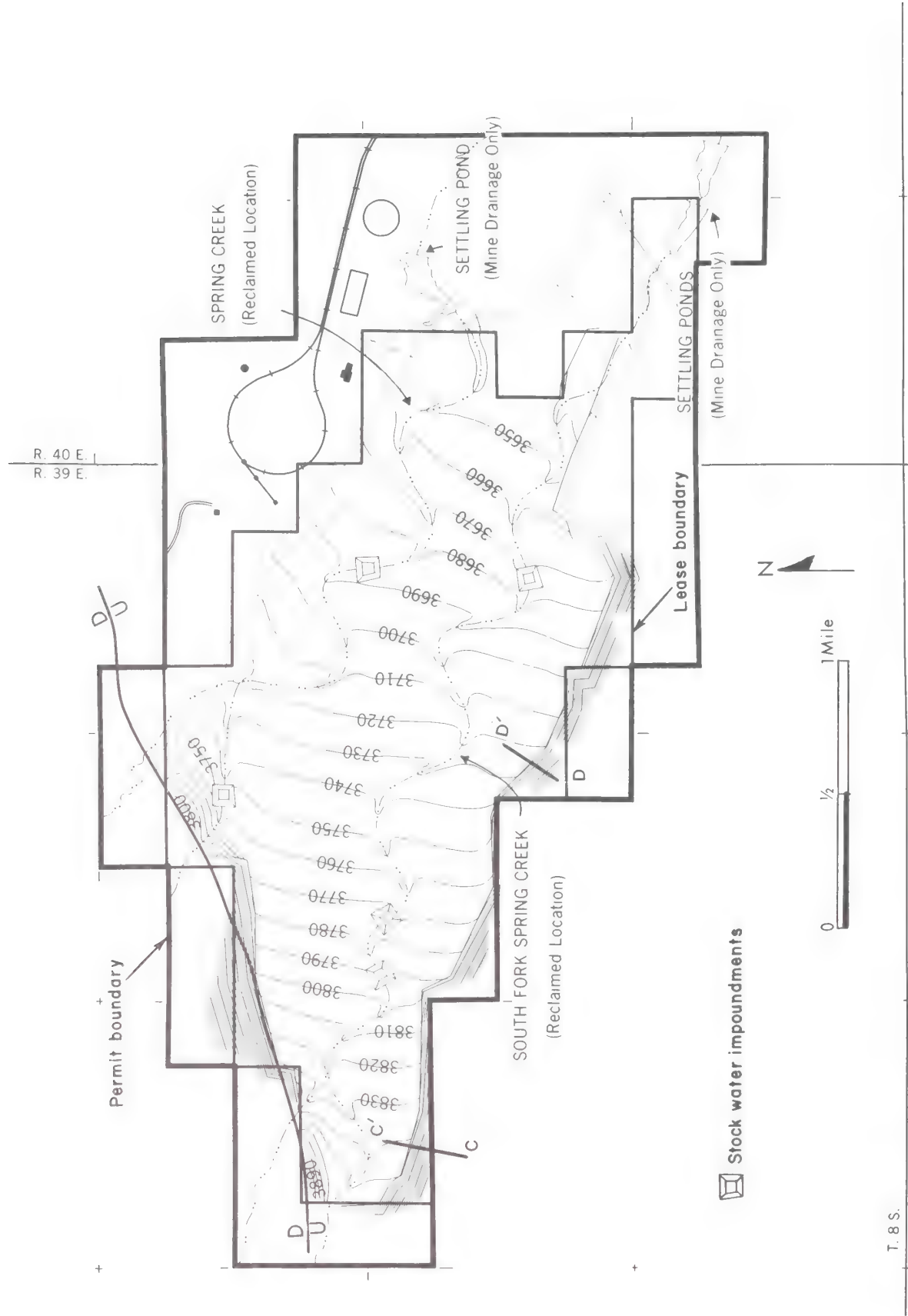


FIGURE I-19.--Postmining topography. (See figure I-15 for cross sections C-C' and D-D'.)

e. Postmining stream reclamation

After the completion of mining and reclamation, Spring Creek and South Fork Spring Creek would occupy channels within reconstructed flood plains located on the reclaimed mine area. The flood plains would be stabilized by vegetation and the low-flow channels would have gradients similar to those of the presently-active stream channels.

The Spring Creek flood plain would be 10,500 feet long and would start at an elevation of 3,720 and end at an elevation of 3,620 (a gradient of one-half degree). This flood plain would be 250 feet wide with a 200-foot-wide bottom and 25-foot-wide sides having slopes of 10:1. The low-flow channel would be 18,200 feet long and would be trapezoidal in shape with an 8-foot-wide bottom. The total depth would be 2 feet and side slopes would be 2:1, resulting in a 16-foot-wide top.

The South Fork Spring Creek flood plain would be 22,500 feet long and would start at an elevation of 3,850 and end at an elevation of 3,600 (a gradient of two-thirds of a degree). The flood plain would be 200 feet wide with a 150-foot-wide bottom and 25-foot-wide sides having slopes of 12.5:1. The low-flow channel would be trapezoidal in shape and would be 39,000 feet long with an 8-foot-wide bottom. The total depth would be 2 feet and side slopes would be 2:1, resulting in a 16-foot-wide top.

f. Ponds

Stock watering ponds would be constructed on both Spring Creek and South Fork. These ponds would be excavated so that the bottom of the ponds would be 10 feet below the flood plain level. The ponds would be 200 feet square at the bottom and would have side slopes of 10:1. There would be two ponds on Spring Creek and 3 ponds on South Fork (fig. I-19).

g. Seeding

Upon the completion of seedbed preparation, areas to be reclaimed would be seeded or planted during the first appropriate season, not to exceed 90 days from the date of seedbed preparation. The goals of reclamation would be to establish a permanent, diverse vegetation cover of predominantly native species on all affected lands except traveled parts of the railroad and roadways or areas of authorized water confinement.

In accordance with State and Federal laws, the company proposes to drill-seed reclaimed areas with locally grown, genotypical seed, when available. Seeding would be done on the contour. Six site-specific seeding mixtures have been developed for the Spring Creek permit area based upon preplanning vegetation inventories, the proposed reclamation use, and pertinent laws. These six seeding mixtures are included in table I-3. Figure I-20 shows the proposed areas where each mixture would be planted. Reclamation work would be monitored continuously by qualified reclamation specialists employed by the company.

TABLE I-3.--Seeding mixtures

[Rates indicated are pounds of pure live seed per acre]

Rate (lb/acre)	Common name	Scientific name
Area 1: Highwall reduction--South-facing slopes		
0.5	Rubber rabbitbrush-----	<u>Chrysothamnus nauseosus</u>
0.5	Schadscale saltbush-----	<u>Atriplex confertifolia</u>
1	Winterfat-----	<u>Eurotia lanata</u>
1	4-Wing saltbush-----	<u>Atriplex canescens</u>
2	Western wheatgrass-----	<u>Agropyron smithii</u>
3	Green needlegrass-----	<u>Stipa viridula</u>
2	Beardless wheatgrass-----	<u>Agropyron inerme</u>
2	Indian ricegrass-----	<u>Oryzopsis hymenoides</u>
3	Critana thickspike-----	<u>Agropyron dasystachyum</u>
2	Bottlebrush squirreltail-----	<u>Sitanion hystrix</u>
2	Slender wheatgrass-----	<u>Agropyron trachycaulum</u>
Area 2: Highwall reduction--North-facing slopes		
1	Skunkbush sumac-----	<u>Rhus trilobata</u>
1	Antelope bitterbrush-----	<u>Purshia tridentata</u>
1	Winterfat-----	<u>Eurotia lanata</u>
1	4-Wing saltbush-----	<u>Atriplex canescens</u>
3	Western wheatgrass-----	<u>Agropyron smithii</u>
3	Green needlegrass-----	<u>Stipa viridula</u>
2	Sideoats grama-----	<u>Bouteloua curtipendula</u>
2	Prairie sandreed-----	<u>Calamovilfa longifolia</u>
2	Little bluestem-----	<u>Andropogon scoparius</u>
2	Beardless wheatgrass-----	<u>Agropyron inerme</u>
2	Thickspike wheatgrass-----	<u>Agropyron dasystachyum</u>
In addition to this seeding mixture, selected plantings of ponderosa pine (<u>Pinus ponderosa</u>) and juniper (<u>Juniperus scopulorum</u>) will also be made.		
Area 3: Stream channel and flood plains		
2	Prairie sandreed-----	<u>Calamovilfa longifolia</u>
3	Smooth brome-----	<u>Bromus inermis</u>
3	Western wheatgrass-----	<u>Agropyron smithii</u>
3	Streambank wheatgrass-----	<u>Agropyron riparium</u>
3	Pubescent wheatgrass-----	<u>Agropyron trichophorum</u>
2	Silver sage ¹ -----	<u>Artemisia cana</u>

¹The seed to be utilized will be hand collected on the site and will be seeded into a 200-foot buffer zone along the stream channel.

TABLE I-3.--Seeding mixtures--Continued

Rate (lb/acre)	Common name	Scientific name
Area 4: North of Main Fork Spring Creek		
1	Shadscale saltbush-----	<u>Atriplex confertifolia</u>
1	4-Wing saltbush-----	<u>Atriplex canescens</u>
3	Western wheatgrass-----	<u>Agropyron smithii</u>
3	Green needlegrass-----	<u>Stipa viridula</u>
3	Beardless wheatgrass-----	<u>Agropyron inerme</u>
2	Bottlebrush squirreltail-----	<u>Sitanion hystrix</u>
3	Thickspike wheatgrass-----	<u>Agropyron dasystachyum</u>
2	Slender wheatgrass-----	<u>Agropyron trachycaulum</u>
Area 5: East of sec. lines 25 and 26--Predominantly cool season grasses		
2	Western wheatgrass-----	<u>Agropyron smithii</u>
2	Green needlegrass-----	<u>Stipa viridula</u>
2	Pubescent wheatgrass-----	<u>Agropyron trichophorum</u>
2	Blue grama-----	<u>Bouteloua gracilis</u>
2	Sideoats grama-----	<u>Bouteloua curtipendula</u>
2	Indian ricegrass-----	<u>Oryzopsis hymenoides</u>
2	Beardless wheatgrass-----	<u>Agropyron inerme</u>
2	Bottlebrush squirreltail-----	<u>Sitanion hystrix</u>
2	Little bluestem-----	<u>Andropogon scoparius</u>
1	Skunkbush sumac ² -----	<u>Rhus trilobata</u>
1	4-Wing saltbush ² -----	<u>Atriplex canescens</u>
Area 6: West of sec. lines 25 and 26--Predominantly warm season grasses		
3	Little bluestem-----	<u>Andropogon scoparius</u>
3	Sideoats grama-----	<u>Bouteloua curtipendula</u>
2	Switchgrass-----	<u>Panicum virgatum</u>
2	Thickspike wheatgrass-----	<u>Agropyron dasystachyum</u>
2	Beardless wheatgrass-----	<u>Agropyron inerme</u>
2	Blue grama-----	<u>Bouteloua gracilis</u>
2	Western wheatgrass-----	<u>Agropyron smithii</u>
2	Prairie sandreed-----	<u>Calamovilfa longifolia</u>
1	Skunkbush sumac ² -----	<u>Rhus trilobata</u>
1	4-Wing saltbush ² -----	<u>Atriplex canescens</u>

²Selected corridor areas for wildlife access to water.

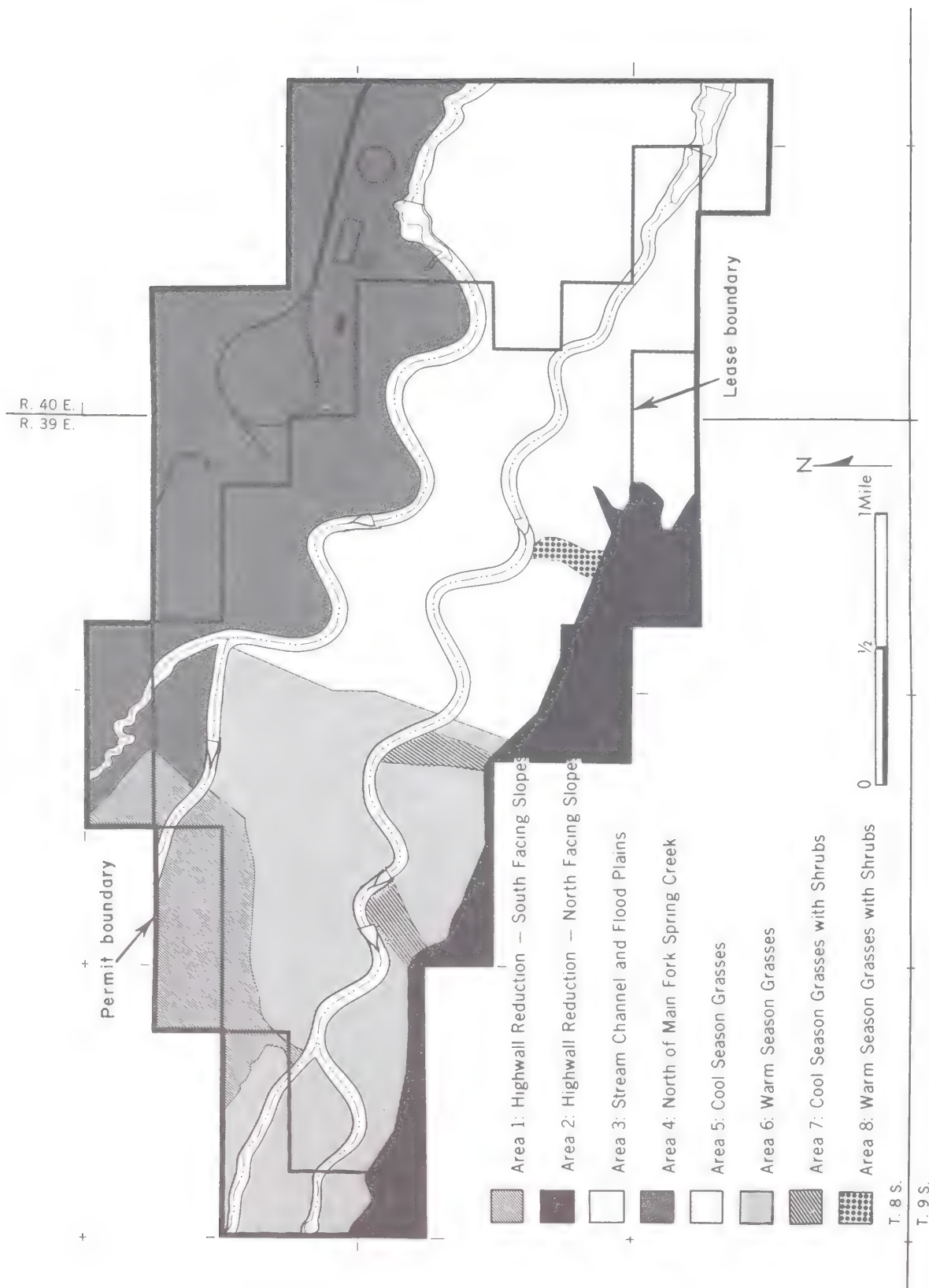


FIGURE I-20.--Map showing proposed reclamation vegetation.

3. Abandonment of Mine

After mining operations cease, buildings and access facilities would be removed and sites occupied by them would be reclaimed by replacing topsoil and revegetation. The company anticipates that about 2 years would be required for reclamation of those areas.

4. Employment Requirements

During the first few years of construction and production, the number of employees would vary (table I-4). The company anticipates that a peak employment force of about 480 employees would be hired on a nonpermanent basis, with peak employment occurring in April or May 1980. Construction is scheduled to be completed in late 1980 should the permit be approved within the time frames anticipated by the company.

The company has proposed the building of a temporary construction camp for employees during the initial stages of mine development. The facilities would be in the SW1/4NE1/4 sec. 32, T. 9 S., R. 40 E., Big Horn County, Montana. The camp would consist of a motel-type bachelors' quarters, recreational vehicle hookups, mobile home spaces, and a dining and recreation hall. Food service, maid service, and security would be provided. The camp would accommodate about 220 or more people. (See Taylor and Associates, 1978.)

A permanent work force would be hired in accordance with the figures shown in table I-4. Permanent employment would stabilize at about 250 employees in mining-year four.

D. ADDITIONAL REQUIREMENTS TO MEET STATE AND FEDERAL REGULATIONS

1. General

- Any Federal action that results in the disturbance of migratory and raptorial birds, their eggs, and/or nests must comply with regulations of the Migratory Bird Treaty Act, the Bald Eagle Act, the Endangered Species Act, and the Fish and Wildlife Coordination Act.
- If the company desires variances from the requirements which relate to the sampling of overburden, the company must obtain a letter from the U.S. Geological Survey authorizing such variances.
- The application for a surface mining permit must demonstrate compliance with the Strip Mining Control and Reclamation Act of 1977, the regulations pursuant to that act, and the Montana Emergency Reclamation Act of 1973.
- The company must present a discussion of the feasibility of mining the Canyon coal bed in order for the mining plan to be evaluated under the State and Federal coal conservation acts and the Federal Coal Leasing Amendments Act.

TABLE I-4.--Spring Creek project work force schedule

Job category	Number employed (by quarter)															
	Year 1				Year 2				Year 3				Year 4			
	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	Years 5-25
Salaried and supervisory																
Mine Manager-----	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Admin. Manager-----	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Mine Supt.-----	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Asst. Mine Supt.---	-	-	-	-	-	1	1	1	1	1	1	1	1	1	1	1
Shift Supervisors---	-	-	-	-	-	1	2	2	3	4	4	4	6	6	8	8
Maint. Supt.-----	-	-	-	-	1	1	1	1	1	1	1	1	1	1	1	1
Asst. Maint. Supt.---	-	-	-	-	-	-	1	1	1	1	1	1	1	1	1	1
Electrical Supt.---	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Coal Prep. Supt.---	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Mater. and Sched. Superintendent-----	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Storekeeper-----	-	-	-	1	1	1	1	1	2	2	2	2	3	3	3	3
Warehouse Clerk---	-	-	-	-	-	-	-	1	1	1	1	1	1	1	1	1
Mine Engineer-----	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Asst. Mine Engr.---	-	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2
Sr. Eng. Tech.-----	1	1	1	1	1	1	1	2	2	2	2	2	2	3	3	3
Eng. Aide-----	1	1	1	1	1	1	1	1	1	1	2	2	2	2	3	3
Geologist-----	-	-	-	1	1	1	1	1	1	1	1	1	1	1	1	1
Reclamation Cord.--	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Safety Engr.-----	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Training Supervisor	-	-	-	-	-	-	1	1	1	1	1	1	1	1	1	1
Secty-Clrk-Recpt.--	1	1	1	1	2	2	2	2	3	3	3	3	3	3	3	3
Total salaried-----	11	13	13	15	17	19	22	24	28	29	30	30	33	34	37	37
Overburden removal																
Dragline Operator---	-	-	-	-	-	-	1	1	1	1	2	2	3	3	4	4
Shovel Operator---	-	-	-	-	-	-	1	1	1	2	2	2	2	3	3	3
Driller-Shooter---	-	-	-	-	-	-	2	2	3	4	4	5	6	6	6	6
Dozer Operator---	-	-	-	-	-	-	1	1	1	1	2	2	3	3	4	4
Dragline Oiler---	-	-	-	-	-	-	1	1	1	1	2	2	3	3	4	4
Shovel Oiler---	-	-	-	-	-	-	1	1	2	2	2	2	3	3	3	3
Driller Helper---	-	-	-	-	-	-	2	2	2	3	4	4	5	6	6	6
Truck Drivers-----	-	-	-	-	-	-	6	6	6	12	12	12	12	18	18	18
Coal mining																
Shovel Operator---	-	-	-	-	-	-	-	1	1	1	2	2	3	3	4	4
Driller-Shooter---	-	-	-	-	-	-	-	1	1	1	2	2	3	3	4	4
Loader Operator---	-	-	-	-	-	-	1	1	1	1	2	2	2	2	2	2
R.T. Dozer Operator	-	-	-	-	-	-	-	1	1	1	2	2	2	2	2	2
Shovel Oiler---	-	-	-	-	-	-	-	1	1	1	2	2	3	3	4	4
Driller Helper---	-	-	-	-	-	-	-	1	1	1	2	2	3	3	4	4
Truck Drivers-----	-	-	-	-	-	-	-	9	9	9	17	17	26	26	34	34
Roads, drainage, reclamation																
Grader Operator---	-	1	1	1	1	1	2	2	2	2	4	4	4	5	7	7
Scraper Operator---	1	1	2	2	2	2	2	2	2	2	4	4	4	4	6	6
Dozer Operator---	1	1	2	2	2	3	3	3	3	6	6	6	6	8	8	8
Water Truck Driver	-	1	1	1	1	1	1	1	1	2	2	2	3	4	5	5
Labor-----	-	1	2	2	2	2	2	2	2	2	2	2	4	4	6	6
Coal preparation and loading																
Coal Hand. Wk. Foreman-----	-	-	-	-	-	1	1	1	1	1	2	2	3	3	4	4
Equipment Oiler---	-	-	-	-	-	1	1	1	1	1	2	2	3	3	4	4
Coal Handler-----	-	-	-	-	-	-	-	1	1	1	2	2	3	3	4	4
Warehouse																
Supply Truck Driver	-	-	-	-	-	1	1	1	1	1	1	1	1	1	1	1
Helper-----	-	-	-	-	-	1	1	1	1	2	2	2	3	3	3	3
Equipment maintenance																
Mech. Foreman-----	-	-	-	-	-	1	1	1	1	1	1	1	1	1	1	1
Mech. Wk. Foreman---	-	-	-	-	-	1	1	2	2	2	2	2	2	3	3	3
Elect. Wk. Foreman	-	-	-	-	1	1	1	1	1	2	2	2	2	3	3	3
Weld. Wk. Foreman---	-	-	-	-	-	1	1	1	1	2	2	2	2	3	3	3
Mechanic-----	-	-	-	-	-	4	4	7	7	8	10	12	14	16	16	16
Electrician-----	-	-	-	-	2	2	3	4	4	6	7	7	7	9	9	9
Welder-----	-	-	-	-	-	2	4	4	4	6	7	7	7	9	9	9
Machinist-----	-	-	-	-	-	1	1	1	1	1	1	1	1	1	1	1
Lube Technician---	-	-	-	-	-	1	2	2	2	2	2	2	2	2	2	2
Lube Helper-----	-	-	-	-	-	1	1	1	1	2	2	2	4	4	5	5
Helper-----	-	-	-	-	-	3	3	4	4	6	6	6	8	10	12	12
Total hourly-----	2	5	8	8	11	29	51	73	73	97	128	130	162	187	216	216
Grand total-----	13	18	21	23	28	48	73	97	101	126	158	160	195	221	253	253

- . The company will have to obtain a preconstruction permit from EPA demonstrating: (1) compliance with the prevention of significant deterioration (PSD) increments in effect at the leasehold (2) compliance with the Northern Cheyenne Indian Reservation Class I PSD increments, and (3) the use of best available control technology to control atmospheric emissions.
- . The company must comply with Section 106 of the National Historic Preservation Act of 1966 (16 USC Section 470f, as amended, 90 Stat. 1320) and the Advisory Council's "Procedures for the Protection of Historic and Cultural Properties" (36 CFR 800) prior to approval of any undertaking which will affect cultural properties included in, or eligible for inclusion in, the National Register of Historic Places.

2. Construction

- . The Montana Department of State Lands may require that access roads be graded, constructed, and maintained in accordance with the following requirements:

No sustained grade shall exceed 8 percent.

The maximum pitch grade shall not exceed 12 percent for 300 feet.

There shall not be more than 300 feet of maximum pitch grade for each 1,000 feet.

The grade on switchback curves shall be reduced to less than the approach grade and shall not be greater than 10 percent.

Cut slopes shall not be more than 2:1 in soils or 1/2:1 in rock.

All grades referred to shall be subject to a tolerance of 2 percent of measurement. Linear measurements shall be subject to a tolerance of 10 percent of measurement.

Additional requirements may be imposed by the department if special drainage or steep terrain problems are likely to be encountered.

- . All cut and fill slopes resulting from construction of access roads, railroad loop, or haul roads outside the area to be mined shall be stabilized, and revegetated during the first seasonal opportunity.

- . Drainage ditches shall be constructed on both sides of the through-cut, and the inside shoulder of a cut-fill section, with ditch-relief cross drains being spaced according to grade. Water shall be intercepted before reaching a switch-back or large fill, and shall be drained off or released below the fill. Drainage structures shall be constructed in order to cross a stream channel and shall not affect the flow or sediment load of the stream.
- . Clinker should be placed at the discharge points of the outlet pipes of the settling ponds.

3. Mining

- . Terracing may be required to conserve moisture and to control water erosion on all graded slopes during the grading process.
- . All mining activities, including highwall reduction and related reclamation, shall cease 100 feet from a property line; from a permanent structure; from unminable, steep, or precipitous terrain; or from any area determined by the Montana Department of State Lands, with concurrence of the Secretary of the Interior, to be of unique scenic, historical, cultural, or other unique value pursuant to Section 522 of the Surface Mining Control and Reclamation Act and Section 9 (82-4-227 MCA) of the Montana Strip and Underground Mine Reclamation Act.
- . Haul roads shall be permitted only in accordance with State and OSM regulations provided that their presence does not delay or prevent recontouring or revegetation on immediately adjacent spoils.
- . The company must receive approval from the regulatory agencies prior to the utilization of chemical dust suppressants.
- . Paleontological resources are protected under the Montana State Antiquities Act (Part 4, Chapter 3, Title 22, MCA) and the Federal Antiquities Act of 1906.

4. Reclamation

- . Materials which are not conducive to revegetation techniques, establishment, and growth shall not be left on the top or within 8 feet of the top of regraded spoils or at the surface of any other affected areas. The Montana Department of State Lands may require that problem materials be placed at a greater depth.

- . Box-cut spoils or portions thereof shall be hauled to the final cut, if--

Excessively large areas of the mine perimeter would be disturbed by proposed methods for highwall reduction or regrading of box-cut spoils. Or--

Material shortages in the area of the final highwall or spoil excesses in the area of the box cut would be likely to preclude effective recontouring.

- . All backfilling and grading shall be completed within 90 days after the Department of State Lands has determined that the operation is completed or that a prolonged suspension of work in the area would occur.
- . In all cases the final pit shall be backfilled so as to cover all exposed coal seams with at least 4 feet of nontoxic fill materials.
- . The transition from undisturbed ground shall be blended with cut or fill or provide a smooth transition in topography.
- . Stockpiles of salvaged topsoil shall be located in areas where they would not be disturbed by ongoing mining operations and would not be lost to wind erosion or surface runoff. All unnecessary compaction and contamination of the stockpiles shall be prevented; and the topsoil, once stockpiled, shall not be rehandled until replaced on regraded disturbed areas.
- . The mine operator shall take all measures necessary to assure the stability of topsoil on graded spoil slopes.
- . Any application for permit or accompanying reclamation plan which for any reason proposes to use materials other than, or along with, topsoil for final surfacing of spoil or other disturbances shall document problems of topsoil quantity or quality. The application or plan must also show that the topsoil substitute proposed.

Would not contribute to or cause pollution of surface or underground waters.

Would support a diverse cover of predominantly native perennial species equivalent to that existing on the site prior to any mining related disturbance.

- . Temporary cover crops to be used must be specified and seeding rates included. If millet is to be used, its suitability should be referenced.

5. Abandonment

- . Upon abandonment of any road or railraod loop, the area shall be conditioned and seeded and adequate measures taken to prevent erosion by means of culverts, water bars, or other devices. Such devices shall be abandoned in accordance with all provisions of Chapter 325, Session Laws of Montana, 1973, and MAC 26-2.10 (10)S-10330 and MAC 26.210(10)-S10340 of the Rules and Regulations adopted pursuant thereto. Upon completion of mining and reclamation activities, all roads shall be closed and reclaimed unless the landowner requests in writing, and the Montana Department of State Lands concurs, that certain roads or specified portions thereof are to be left open for future use.
- . In the case of abandoned roads, the roadbeds shall be ripped, disced, or otherwise conditioned before topsoil is replaced. The Montana Department of State Lands may prescribe additional alternate conditioning methods for the reclamation of abandoned roadbeds.

CHAPTER II

DESCRIPTION OF THE ENVIRONMENT

A. GEOLOGY

1. Topography and Geomorphology

The topography of the Spring Creek area is typical of the northwestern Powder River Basin (fig. II-1). The area is drained by two southeastward-flowing ephemeral streams: Spring Creek and South Fork Spring Creek. The two streams join approximately 1.5 miles east of the mine area, within the boundaries of the proposed North Extension Decker mine. Prominent bluffs occur along the ridge dividing the two streams and along the south valley wall of South Fork. Total relief is approximately 420 feet, the highest elevation in the area to be mined being about 3,995 feet at the northwestern end of the central ridge.

Field evidence from the mine area indicates natural rates of erosion and deposition of at least 1,200 to 2,000 tons per square mile per year (David Dossett, OSM, oral communication, 1977). This rate of erosion is attributed to the semiarid climate and a resulting limited vegetation cover and is considered to be relatively high compared with the United States as a whole. Most erosion at the present time occurs from sheetwash; more serious forms of erosion, such as rills and gullies, have not been observed. Erosion rates have probably been accelerated by livestock grazing and by man's recent activities (primarily through off-road travel) related to coal exploration and environmental baseline studies. Erosion rates reach their greatest natural levels during spring thaw and periods of intense or prolonged rain.

2. Stratigraphy and Overburden

The Spring Creek coal field is actually a northwestward extension of the Decker coal field (Matson and Blumer, 1973). The exposed rocks consist of Holocene (recent) alluvium and sediments of the Tongue River Member of the Fort Union Formation (fig. II-2). The overlying Wasatch Formation occurs at higher elevations along the southern and northwestern boundary of the permit area. The near-surface subbituminous coal beds are part of the Fort Union Formation and are named the Anderson, the Dietz no. 1, and the Dietz no. 2, respectively. In the permit area these seams merge to form a single seam averaging about 81 feet in thickness. (See chapter I for additional information.) The Canyon coal, about 19 feet thick, lies about 106 feet below the base of the Dietz no. 2 coal seam in the permit area (fig. II-3).

Aquifers beneath the permit area include the alluvium in the valley of South Fork Spring Creek, the Anderson-Dietz coal seam, and the Canyon coal and associated sandstones. (See Hydrology.)

The interburden between the base of the Dietz no. 2 and the Canyon coal beds would not be affected by the proposed mining operation. Therefore, this discussion will address only the overburden above the Anderson-Dietz combined seams.

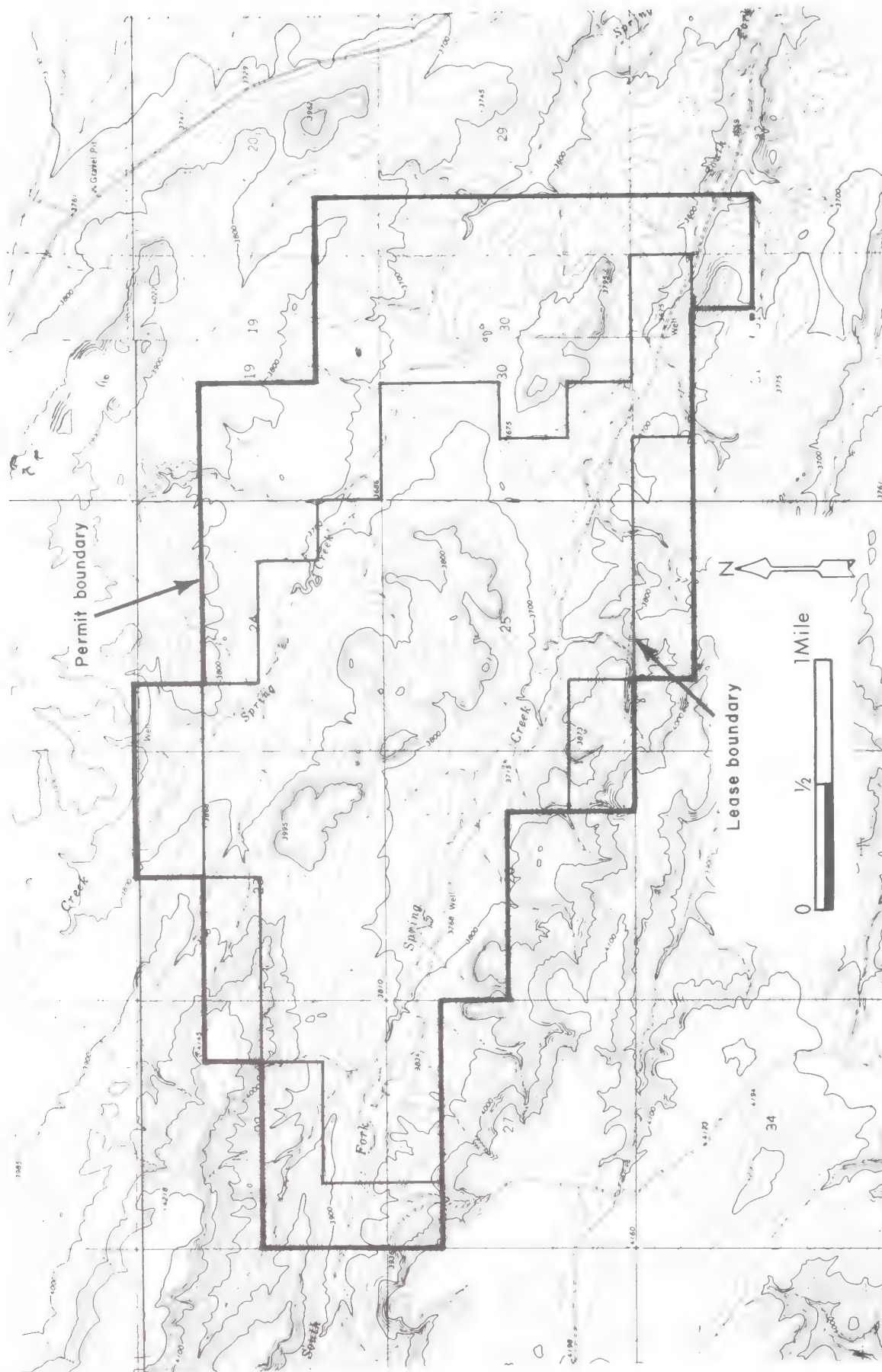


FIGURE II-1.--Topographic map of the Spring Creek area.

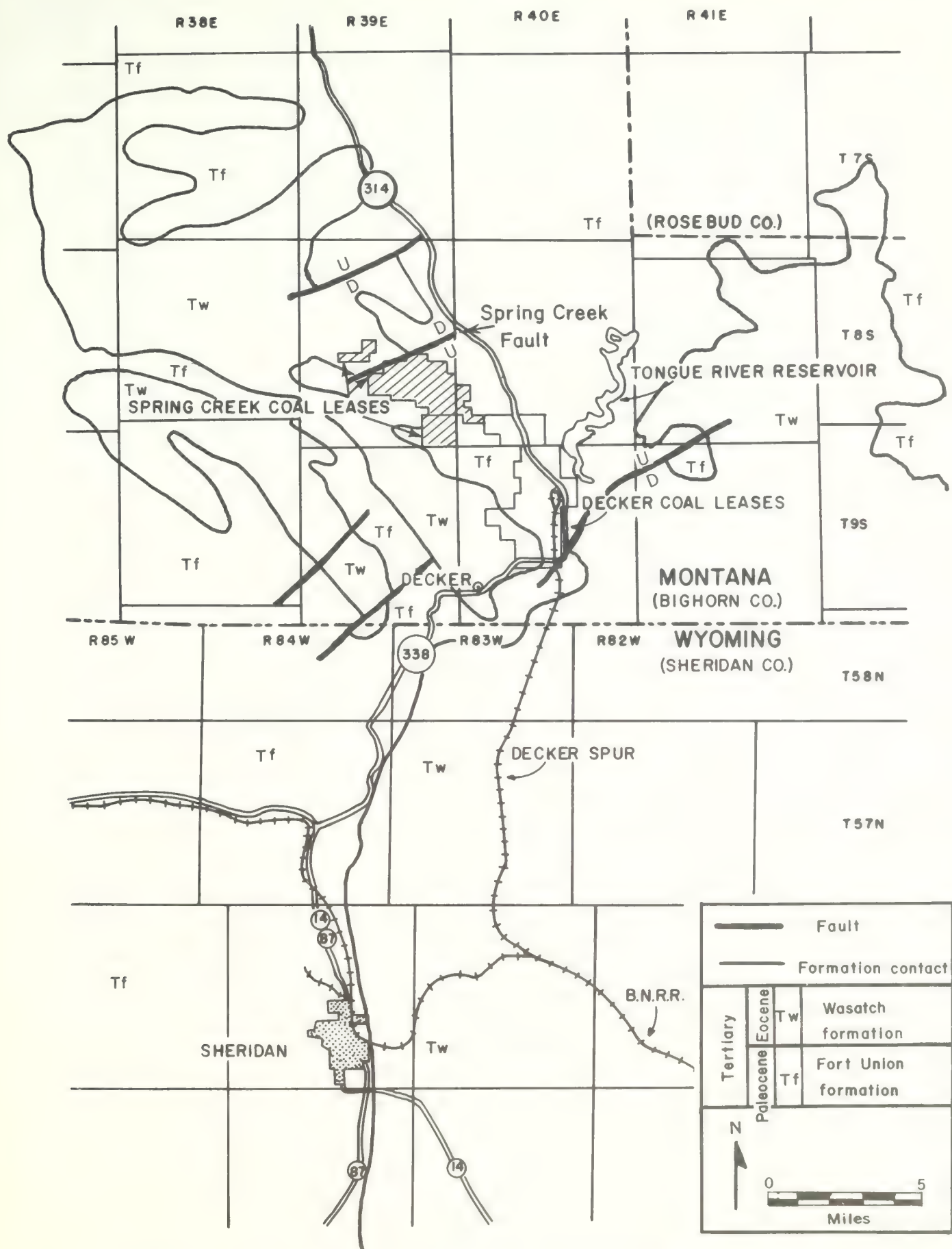


FIGURE II-2.--Regional geologic map showing the Spring Creek area.
(Modified from Keefer, 1974.)

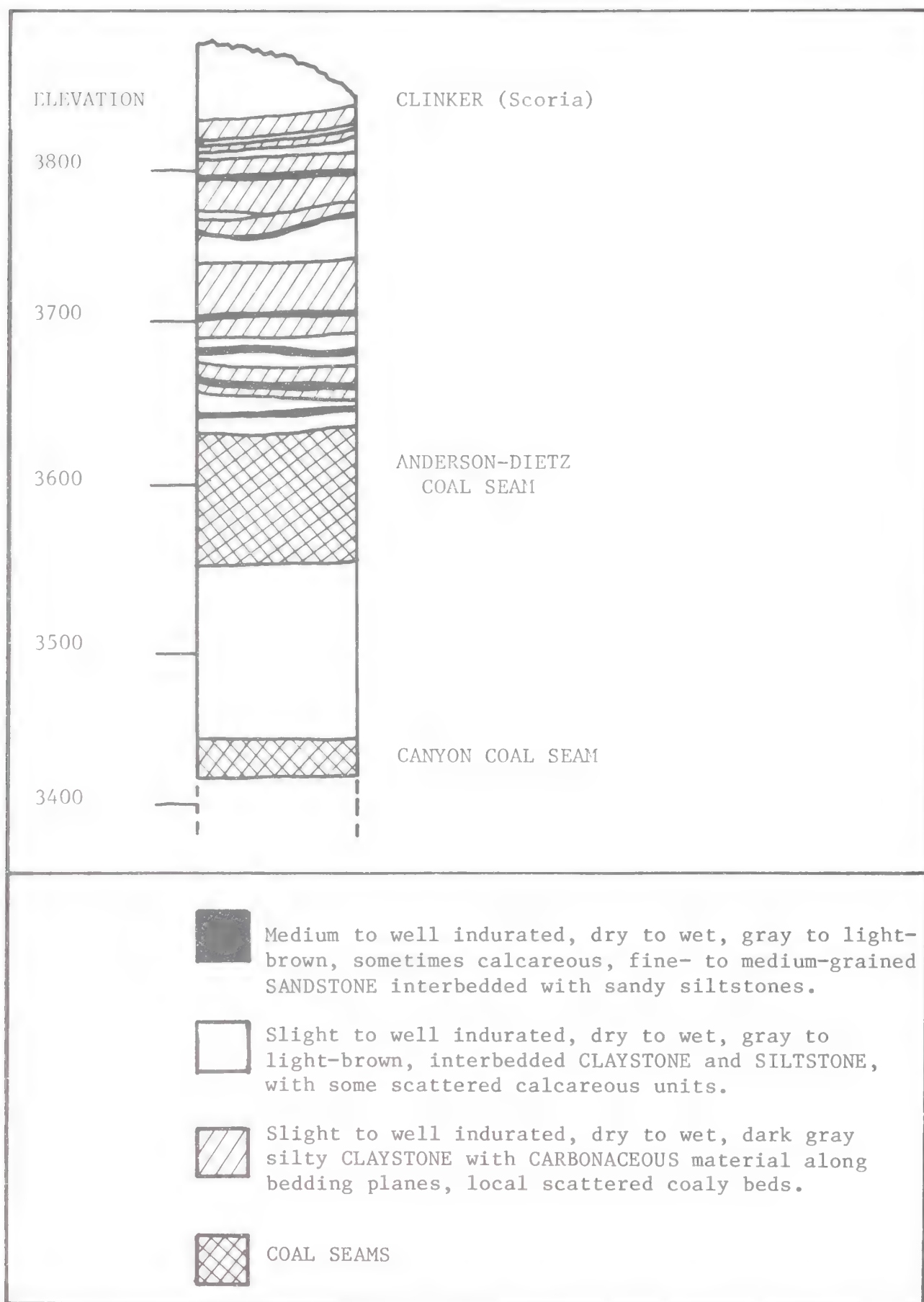


FIGURE II-3.--Geologic column of the Spring Creek coal field. (All rock units are within the Tongue River Member of the Fort Union Formation.)

Overburden in the permit area consists of alluvium of variable thickness, along Spring Creek and South Fork, and of sandstone, siltstone, claystone, and clinker of the Tongue River Member of the Fort Union Formation. The rock units are typically gray to light-brown, clayey siltstone and gray, silty claystone beds alternating with gray-brown indurated fine-grained sandstones. Individual rock units range in thickness from less than 1 inch to 30 feet or more and average about 5 feet. The rocks are poorly to well cemented, most commonly with calcite.

The clayey siltstones and claystones are generally laminated and fissile and contain carbonaceous material scattered along bedding planes. Thin carbonaceous shales and shaley coals occur at various intervals throughout the overburden.

The overburden's minimum thickness is about 15 feet in the northern part of the permit area near the junction of the coal "burn line" and Spring Creek fault. The maximum thickness exceeds 240 feet beneath the topographic highs in the central part of the permit area.

The company has completed geochemical and physical tests on 293 samples from 20 drill holes on the leasehold (fig. II-4). The shallowest samples were taken within 1 foot of the surface; the deepest from less than 1 foot above the top of the Anderson-Dietz coal seam. These samples represent each change in strata (at intervals not less than 2 feet or more than 10 feet) at each drill hole.

Data describing the overburden traits are summarized in table II-1. Levels of cadmium, molybdenum, nickel, and the sodium-adsorption-ratio (SAR)¹ exceed the State suspect levels throughout the mine area.² Levels of manganese, nitrate, pH, and soluble salts vary considerably, and some portions of the overburden contain values exceeding State suspect levels. Concentrations of boron, copper, lead, mercury, selenium, and zinc and the clay content of the overburden all fall below the suspect levels. The physical and chemical characteristics of the overburden are further discussed in appendix A.

3. Structure

The Tongue River Member generally dips less than 1° SE. within the permit area. The beds are locally displaced by minor faults with displacements mostly less than 15 feet but ranging up to about 30 feet. Spring

¹The sodium-adsorption-ratio (SAR) is related to the adsorption of sodium by the soil and is an index of the sodium or alkali hazard of the soil or of water used to irrigate the soil. In the computation of SAR, concentrations of constituents are in equivalents per million.

²State suspect levels are guidelines for various levels of chemical and physical traits of the overburden above which reclamation success is suspect.

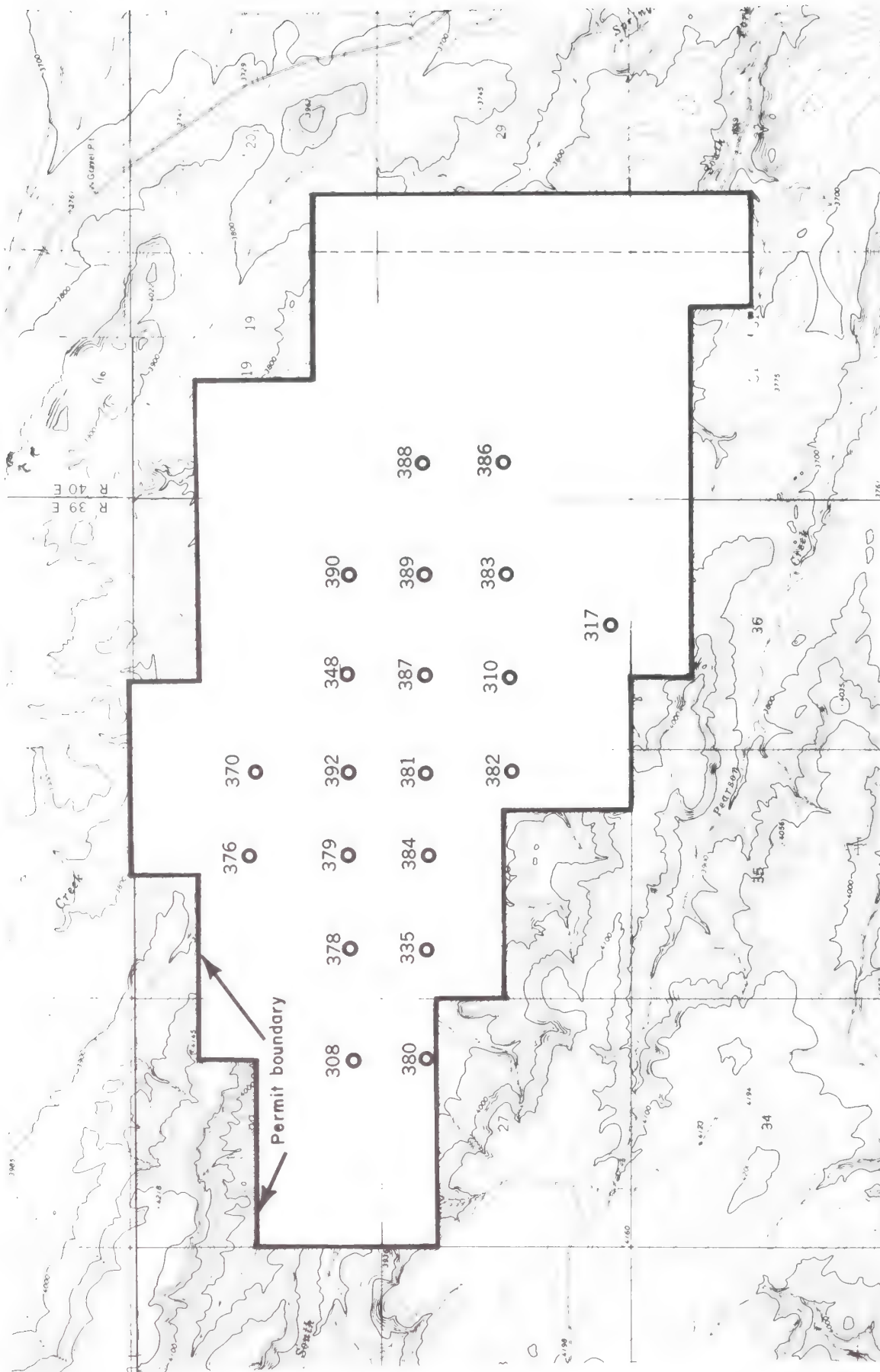


FIGURE II-4.--Locations of test holes in the Spring Creek permit area.

TABLE II-1.--Overburden traits of the Spring Creek field, summary of
drillhole average

Overburden Trait	Arithmetic Mean ¹	Range	State Suspect Level ²	Comments
pH, paste	8.20	7.74-8.87	8.8-9.0	Drill hole #392 exceeds suspect level
Soluble Salts, mmhos/cm	3.82	1.37-6.62	4-6	Drill holes above suspect level identified in text
Na, meq/l	25.87	10.82-39.96		
Ca, meq/l	2.95	0.30-8.26		
Mg, meq/l	9.88	1.13-30.70		
SAR	23.29	4.34-35.32	12	Overburden mean above suspect level
ESP	13.45	3.8-25.5		
P, available, ppm	6.82	3.0-11.2		
K, available, ppm	293.39	208-343		
Nitrate, ppm	17.29	2.4-73.5	Federal livestock threshold 50	Drill holes #370 and #390 exceed suspect level
Ammonium, ppm	30.62	9.3-48.9		
B, Water soluble, ppm	0.69	0.30-1.97	8	All drill holes below suspect level
Mo, NH ₄ Oxylate soluble, ppm	0.76	0.26-1.69	0.3	Overburden mean above suspect level
Se, available, ppm	0.026	0.26-1.69	2.0	All drill holes below suspect level
Cu, DTPA extractable, ppm	5.51	2.6-9.0	40	All drill holes below suspect level
Fe, DTPA extractable, ppm	343.98	140-585		
Mn, DTPA extractable, ppm	34.21	14.0-67.7	60	Drill holes #335, #370, and #382 exceed suspect level
Zn, DTPA extractable, ppm	8.77	3.14-23.17	40	All drill holes below suspect level
Ni, DTPA extractable, ppm	6.82	3.01-9.82	1	All drill holes above suspect level
Cd, DTPA extractable, ppm	0.20	0.20-0.20	0.1-1	All drill holes above suspect level
Pb, DTPA extractable, ppm	4.83	2.9-7.8	15-20	All drill holes below suspect level
Hg, Total, ppb	67.85	33.0-115.0	400-500	All drill holes below suspect level
Clay, %	28.35	24.8-37.4	40	All drill holes below suspect level

¹These values differ from those submitted by applicant which were calculated as a weighted mean.

²These levels are guidelines used by the State in evaluating the suitability of overburden as a revegetation medium.

Creek fault, along the northwest margin of the coal field, has a displacement ranging from 150 to about 200 feet, down to the northwest (fig. II-2).

4. Minerals Other than Coal

Abundant quantities of clinker crop out in the permit area. Small lenses of sand and gravel occur in the alluvium of intermittent streams; they are not considered to be of significant economic value. Commercial quantities of other minerals are not known to exist within the permit area.

Nearly half of the mine area is covered by oil and gas leases. No exploratory oil or gas wells have been drilled on the permit area; however, five such wells, all nonproductive, have been drilled within 2 miles of the leasehold.

5. Paleontology

A preliminary paleontological survey was conducted by Bown and McGrew (1976) to inventory and evaluate potentially significant paleontological resources located in the study area. These investigations consisted of archival review and ground surveys. No important paleontological resources were found within the study area. The fossils found were poorly preserved and/or unidentifiable, and similar plant and animal fossils are much better represented at other sites in equivalent rocks outside the study area. These results, however, do not preclude the possibility of important paleontological materials being exposed during mining activities.

B. HYDROLOGY

1. Surface Water

The permit area is drained by Spring Creek and South Fork Spring Creek southeastward to the Tongue River Reservoir (fig. II-1): Spring Creek drains the northern part, and South Fork the southern part. All streams in the permit area are ephemeral; however, a short reach of South Fork is perennially wet due to a spring that discharges water from the alluvium. There are several stock ponds in the watersheds of Spring Creek and South Fork which reduce runoff through the permit area. During dry periods the only water available for livestock and wildlife use is the alluvial spring and the water in one storage tank at a stock well near the west end of the permit area. Although additional sources of water are located within a few miles, those on the proposed minesite are indispensable for present use patterns.

In addition to the perennial spring, there are seven stock ponds in the permit area, two of which are partially breached and, therefore, of only minor importance. The estimated combined holding capacity of all the ponds is about 25 acre-feet. However, the amount of water contained and the length of time the water is held are highly variable, depending

on weather conditions during a given year. Fed by runoff, the ponds generally contain water in the spring, although they may be dry through the entire year.

The estimated average annual runoff from the Spring Creek drainage below the confluence of Spring Creek and South Fork is about 460 acre-feet, as measured over an 18-year period at the USGS crest-stage station approximately 2 miles southeast of the permit area. Table II-2 summarizes available runoff data for the Spring Creek drainage system. Runoff results from rapid snowmelt and from intense summer thunderstorms. Peak flows have occurred as early as February 14 and as late as September 26, as indicated from records for the period 1958-77. The maximum peak discharge of 1,400 cubic feet per second probably corresponds to about a 25-year-frequency flood.

TABLE II-2.--Annual peak discharge for Spring Creek near Decker, Mont.

[Drainage area: 34.7 mi². Values are annual maximum data]

Water year	Date	Gage height (ft)	Discharge (cfs)
1958	June 7, 1958	3.4	184
1959	Mar. 17, 1959	1.19	45
1960	Mar. 19, 1960	1.31	49
1961	--	--	(*)
1962	June 16, 1962	6.59	**900
1963	June 15, 1963	1.07	40
1964	Apr. 22, 1964	.05	15
1965	Aug. 21, 1965	2.61	362
1966	Sept. 26, 1966	.11	**15
1967	June 12, 1967	2.81	390
1968	June 9, 1968	.72	130
1969	Mar. 18, 1969	1.82	250
1970	May 14, 1970	1.35	195
1971	Feb. 14, 1971	6.50	1,400
1972	Feb. 28, 1972	2.90	420
1973	Sept. 1, 1973	.26	**20
1974	Mar. 28, 1974	1.31	40
1975	Mar. 3, 1975	3.89	240

Annual peak discharges from small drainage areas in Montana.

*No evidence of flow during year.
 **About.

Although long-term data are not available, peak discharges have been calculated for Spring Creek and South Fork near the west end of the mine area, as indicated in table II-3.

TABLE II-3.--Estimated peak discharge (in cfs) for Spring Creek and South Fork Spring Creek

[After Johnson and Omang (1976); Hedman and Kastner (1977)]

	Recurrence intervals (years)					
	2	5	10	25	50	100
Spring Creek----	75	280	500	950	1,460	2,900
South Fork Spring Creek--	50	170	320	630	990	1,580

Other calculations about 2.5 miles downstream on South Fork have indicated a substantial loss in the reach of streams through the permit area. The loss is due in part to infiltration and to some storage in partly breached ponds.

a. Sediment

Premining natural sediment-yield rate is assumed to be 0.5 acre-foot/mi²/yr for undisturbed land (USDA, 1974).

b. Quality

Recent data received from the company indicate that surface water quality in the permit area is suitable for use by livestock and wildlife.

2. Ground Water

Four aquifers have been identified within about 300 feet of the surface in the vicinity of the permit area: the alluvium, the Anderson-Dietz coal, the clinker, and the Canyon coal and its associated sandstones. The horizontal movement of ground water, except for that in the alluvium, is controlled by the gentle southeastward dip, or slope, of the beds toward the Tongue River Reservoir and by the Spring Creek fault. Recent information received from NERCO indicates that Spring Creek fault inhibits ground-water movement into the area from the northwest; however, where Spring Creek fault crosses Spring Creek, in the northern part of the coal lease, the rate of in-flow is relatively high.

Much ground water in the permit area probably originates from local recharge. The downward movement of water in the area is restricted by rocks of low permeability that make up most of the geologic section.

Restriction of the downward movement results in a series of perched zones of saturation separated by unsaturated rock. It is probable, however, that fractures provide avenues of movement even through rocks of low permeability.

a. Alluvial aquifers

Alluvial deposits along the streams are composed of silt, sand, and gravel, with permeabilities that vary depending on the local composition. Where underlain by bedrock having low permeability, these materials are partially saturated, thus forming a local aquifer. The alluvium of Spring Creek contains water only upstream from the Spring Creek fault; southeast of the fault, the alluvium overlies highly permeable clinker and is drained. The alluvium along South Fork contains water except where it overlies clinker in the eastern part of the area. State and Federal regulatory agencies have not determined whether the alluvial deposits in the permit area constitute alluvial valley floors, which remain to be defined pursuant to the Surface Mining Control and Reclamation Act of 1977.

The alluvium is recharged by infiltration from ephemeral streams and is discharged by the transpiration of phreatophytic vegetation of the riparian community, by downward movement into the underlying rocks, and locally by return flow to the stream. The spring supplying perennial water to a short reach of South Fork in the permit area represents such a localized return flow.

The water from the alluvium contains substantial amounts of calcium, magnesium, sodium, bicarbonate, and sulfate ions (appendix B) in concentrations and proportions that make the water suitable for use by livestock and wildlife but poorly suited for domestic or irrigation use. Several wells in the general area obtain water for livestock use from the alluvium. Two of these wells are within the area to be mined (table II-4).

TABLE II-4.--Water wells in and near the Spring Creek permit area

Town- ship	Range	Section	Depth (ft)	Aquifer	Water level (ft)	Use of water
8 S.	39 E.	SW1/4SE1/4 22	58.9	Alluvium	18.76	Stock.
8 S.	39 E.	NW1/4NE1/4 23	39.6	Alluvium	28.74	Unused.
8 S.	39 E.	NW1/4NW1/4 24	218.0	Anderson-Dietz?	117.20	Stock.
8 S.	39 E.	SW1/4NW1/4 24	105.1	Anderson-Dietz?	85.05	Unused.
8 S.	39 E.	NW1/4SW1/4 25	44.5	Alluvium	10.33	Stock.
8 S.	40 E.	NW1/4NE1/4 25	144.6	Anderson-Dietz?	95.86	Stock.

b. Anderson-Dietz aquifer

A water table in the Anderson-Dietz coal, separated from the perched water in the alluvium, ranges from 20 feet below the top of the coal, in the east, to a few feet below the base of the coal near the center of the northwest boundary of the proposed mine near the Spring Creek fault.

The transmissivity is highly variable, from an amount too low to be measured to about 130 ft² per day.

The recharge to the Anderson-Dietz aquifer is largely by downward movement, mainly through fractures, and by lateral movement from the north and west. The general direction of movement in the aquifer is to the east. Discharge from the Anderson-Dietz is by lateral movement into the adjacent clinker and by downward movement to the Canyon aquifer.

The water from the Anderson-Dietz aquifer is of the sodium bicarbonate type. This water, as with that from the alluvium, is usable by livestock but is poorly suited for domestic or irrigation use. No wells receive water from the Anderson-Dietz aquifer within the permit area; however, several nearby wells may obtain part or all of their water from this aquifer (table II-4).

c. Clinker aquifer

Clinker, a highly permeable rock that, in this location, was formed by the burning of the Anderson-Dietz coal, forms an aquifer which lies to the north and east of the area to be mined. Due to its high permeability and the southeastern tilt of the beds, the clinker aquifer readily transmits water out of the permit area. This aquifer is recharged by infiltration from streams, by direct infiltration from the soil zone, and by lateral movement from the Anderson-Dietz coal aquifer. The water quality is variable, depending on the source of recharge; in many places outside the permit area, it is the best quality ground water in the vicinity. It is not known which wells obtain water from the clinker; however, it is possible that some of the wells to the north and east of the proposed mine obtain all or part of their water from this source.

d. Canyon aquifer

The Canyon aquifer is comprised of the Canyon coal and associated sandstones that overlie and perhaps underlie it. In the northwestern part of sect. 26, the interburden between the Anderson-Dietz and the Canyon coals is mostly sandstone; the water level in this hole is 70 feet below the base of the Anderson-Dietz coal and 20 feet above the Canyon coal.

The Canyon aquifer is recharged by downward percolation from overlying rocks, and probably is discharged by upward movement, under pressure, to the alluvium of the Tongue River. The general direction of movement is probably to the east. The water quality is as good as in the shallower aquifers. No wells are known to produce water from the Canyon aquifer in the area.

C. CLIMATE

The climate in the Spring Creek area is continental steppe, typical of the Northern Great Plains. The area is semiarid, characterized by

cold winters, warm summers, abundant sunshine, moderate relative humidity, and low but highly variable precipitation. Most precipitation falls during late spring and early summer as thunderstorms.

The following description of climate in the area is based on a summary published by the U.S. Department of Agriculture (1937, p. 11-12).

"Cold waves occur almost every winter with varying severity, but they are not prolonged, as a rule, and are often broken up for extended periods by warm and pleasant weather usually preceded by the occurrence of chinook winds. Occasionally a warm period is abruptly terminated by a blizzard, a condition characterized by rapidly falling temperature, high winds, snowfall, and poor visibility. Ordinary outdoor occupations may be carried on during the winter with little inconvenience. Late freezing weather and snowfall in May, and in a few districts as late as June, at times lengthen the winter and delay the onset of spring.

"The warm days of summer are tempered by cool nights. While the summer season is usually short, it is made up to a large extent by the long days of abundant sunshine, which, aided by moderately high altitude and a clear, thin atmosphere, rapidly promotes crop growth and largely accounts for the high nutrient quality of the grains and grasses grown here. The cool nights materially help to protect against grain rust. The "chinooks," which are welcome in winter, sometimes become the hot parching winds of summer that bring about a rapid deterioration of grain crops and range grasses within a few days***. Dry fall months usually occur with no severely cold weather until December. The prevailing dryness of the air greatly lessens the discomfort of very cold or hot weather, when compared with the same or less extreme temperatures in more humid sections of the country."

1. Subregional Climatic Factors

a. Precipitation

Precipitation data are available from three stations (fig. II-5). Precipitation at the leasehold is best characterized by the Decker weather station, 11 miles south. The annual average precipitation at Decker is approximately 12.23 inches (average from 1950-76). Forty-five percent of the precipitation in this area occurs between April and June with an additional 25 percent during the remainder of the growing season, until approximately September 30 (fig. II-5). On the average, precipitation occurs 70 days of the year and on 49 of these days (13.4 percent of the year) the amount of precipitation is 0.10 inch or more.

Most of the spring and summer precipitation occurs as thunderstorms, occasionally accompanied by hail and high winds. The heaviest 24-hour storm recorded at Crow Agency was 3.02 inches in August 1964; at Billings, 4.68 inches in April 1941; and at Decker, 3.30 inches in June 1968.

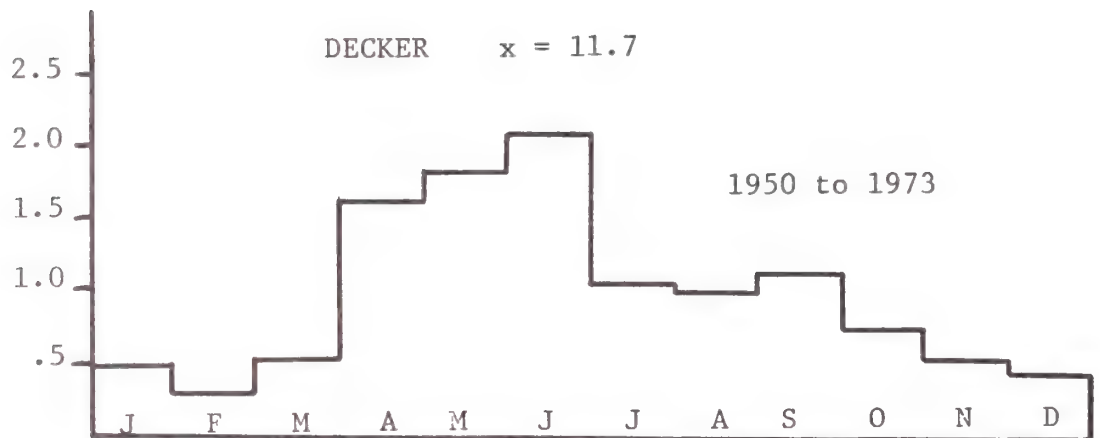
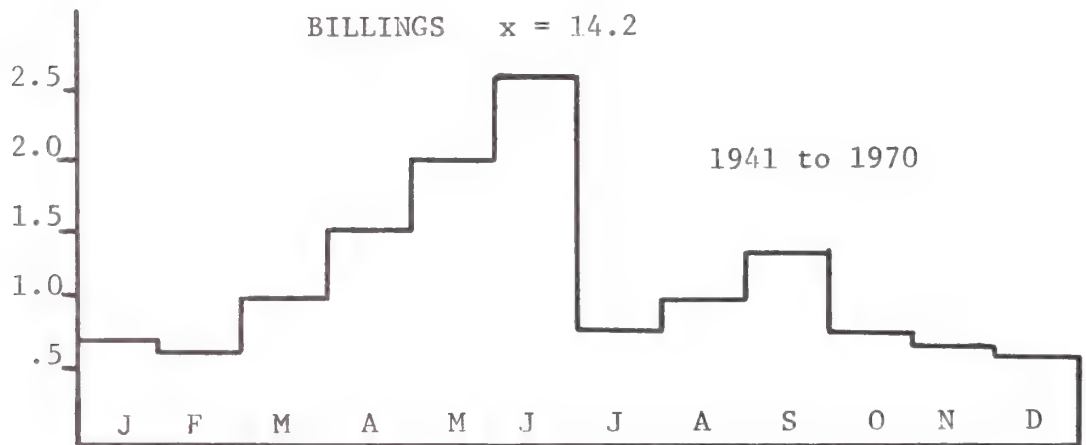
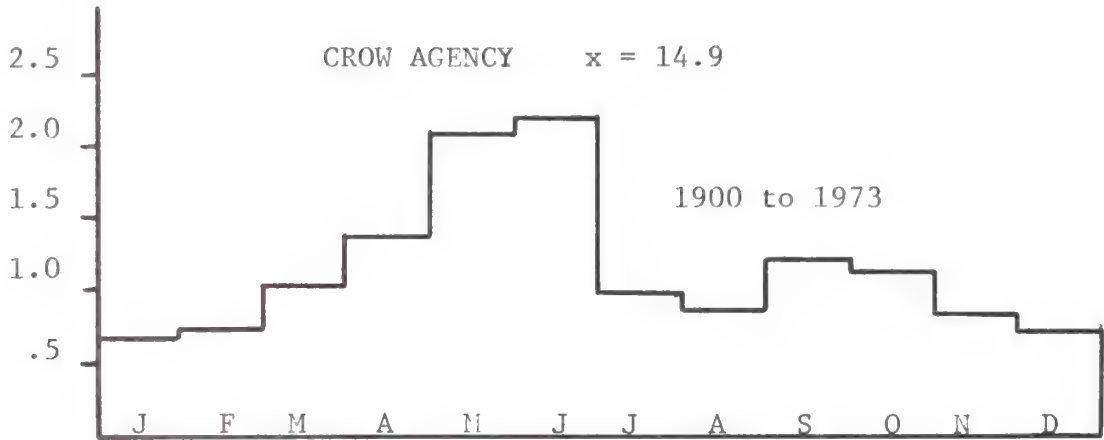


FIGURE II-5.--Annual precipitation profiles.

Return rates for storms of this magnitude are shown in table II-5. A storm of over 2 inches can be expected to occur every 10 years in the vicinity of Decker. Such storms represent a significant portion of the annual precipitation. Such large amounts of precipitation over such a short time period have a very significant impact on erosion, sedimentation rates, and reclamation. (See Soils, Geomorphology, and Vegetation.)

TABLE II-5.--Probability of large precipitation events

[USDC, 1973]

	Return period (yr)					
	2	5	10	25	50	100
Precipitation (inches)	0.4	1.9	2.2	2.7	3.0	3.4

Long-term precipitation records at Billings reflect the variability in precipitation of the area. Both the Billings and the Decker weather data illustrate that the last decade has had above average precipitation (fig. II-6). The long-term cycle illustrates that below average precipitation can be expected some time in the next 20 years.

b. Temperature

Although temperatures do not vary widely throughout the permit area, the diurnal and seasonal variations are large. Daily temperatures may be expected to range from -13°F in winter to 100°F in summer. Regional weather data from Sheridan indicate that the minimum daily temperature could be as low as -35°F and the maximum as high as 106°F (USDC, U.S. Department of Commerce, 1971). The mean annual temperature is 46°F . The warmest month is July, with an average temperature of 71.5°F , and the coldest month is January, with an average temperature of 19.2°F . The diurnal temperature variation during both summer and winter can be greater than 40°F .

The frostfree period (growing season) at Decker is estimated to be 90 to 110 days (USDA, 1972).

c. Wind

Wind data from Spring Creek shows that the dominant surface airflow is from the northwest, downvalley (fig. II-7). The airflow pattern is topographically influenced and is channeled along the valley axis of Spring Creek. Downvalley flow is dominant, however, some upvalley flow occurs during the day and is generally light. The average wind speed at Spring Creek is approximately 7 mph.

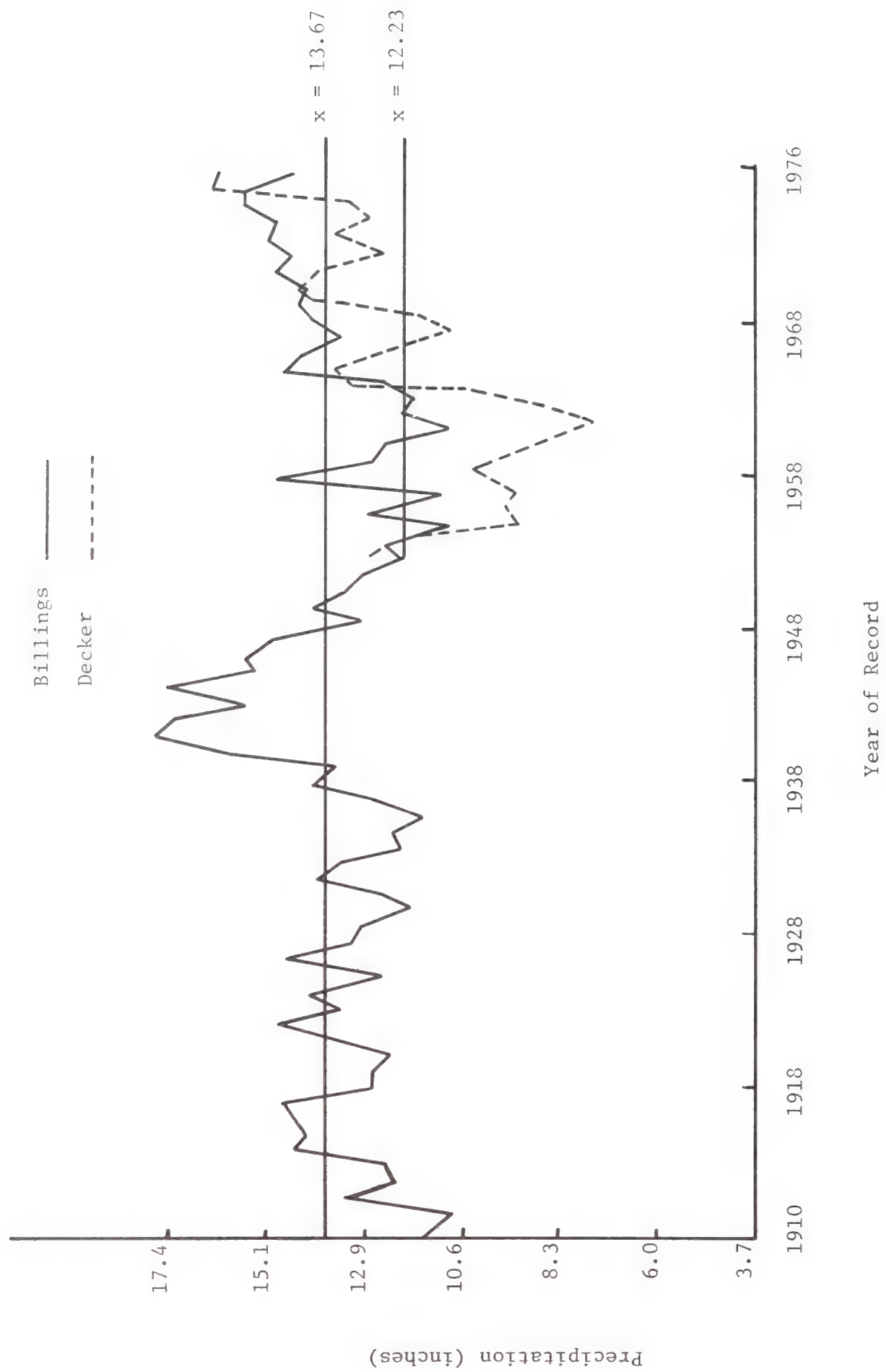


FIGURE II-6.---Three-year running averages of precipitation at Billings and Decker.
(x = mean annual precipitation for the periods shown.)

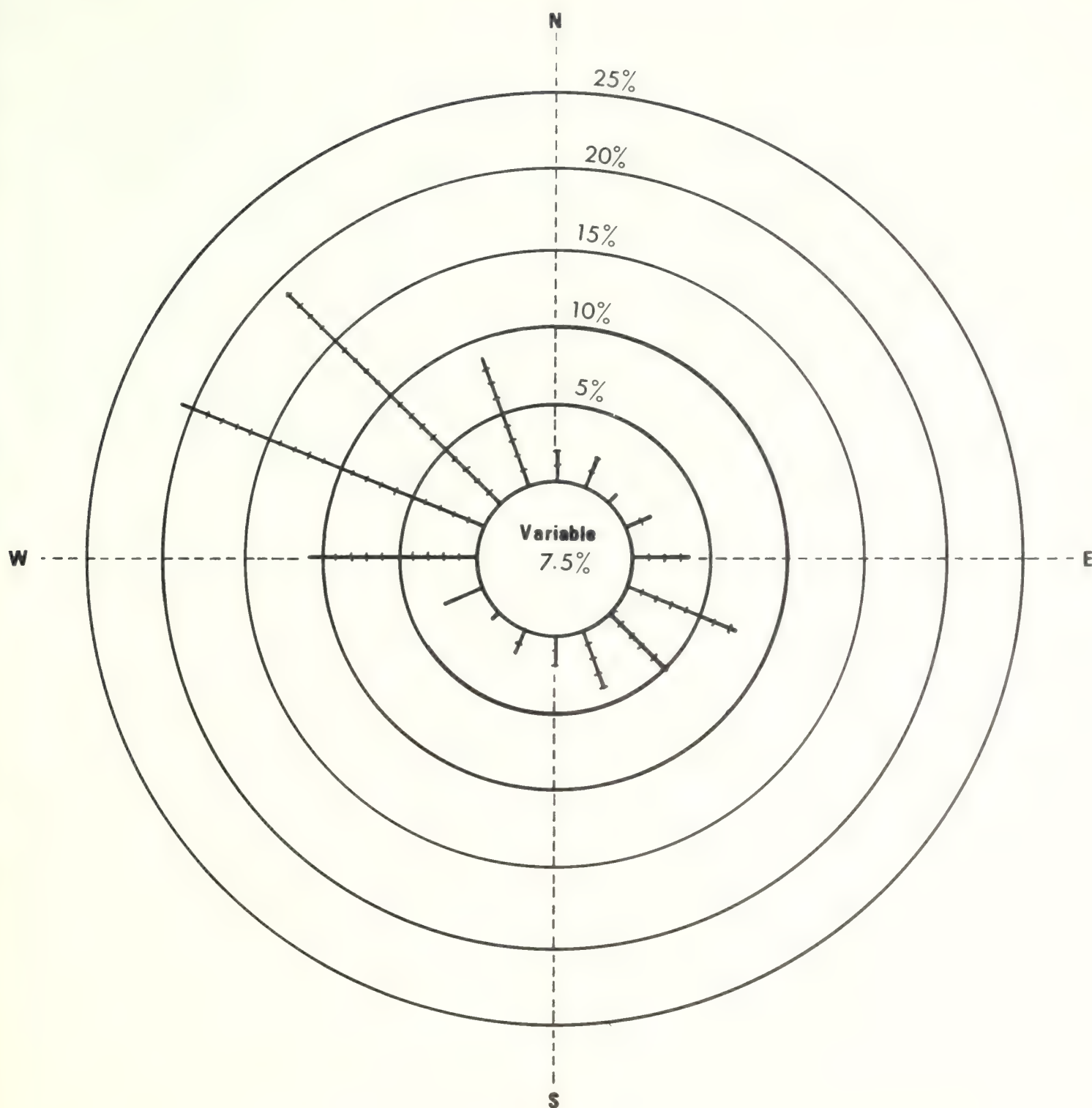


FIGURE II-7.--Annual wind rose for Spring Creek.

d. Microclimate

Microclimates are climatic conditions shaped by small localized topographic, geologic, and vegetative patterns. Those aspects of special concern are temperature, moisture, wind, and solar radiation, all of which are affected by the physical characteristics of a site (slope, aspect, elevation, drainage pattern, soil type, etc.). Microclimates include all localized conditions occurring within a few feet (above and below) the soil surface. The biotic and abiotic factors interact to create a microclimate unique to each site and to create a diverse vegetation mosaic at Spring Creek (16 vegetation communities exist).

D. AIR QUALITY

The Spring Creek area, predominantly upwind of the Decker mining complex, is considered to have pristine air quality. Measured concentrations of total suspended particulates (TSP) and settled particulates on the permit area are well within Federal standards and Montana State guidelines. Gaseous pollutants and visibility characteristics similarly reflect clean air. The Spring Creek area is a "PSD (Prevention of Significant Deterioration) Class II" airshed, a classification which means that although there is no legal requirement to maintain its pristine air quality, excessive degradation would be prohibited. The Northern Cheyenne Reservation has been designated as a Federal Class I air quality region, which means that certain types of air pollution are prohibited on the reservation.

Three high-volume air monitoring stations are in the Spring Creek vicinity (figure II-8). Air sampling results for atmospheric particulates are tabulated in appendix D-1.

The geometric mean for TSP, based on 24-hour average concentrations (measured every sixth day) at the Spring Creek station, was $21.1 \mu\text{g}/\text{m}^3$ with a 24-hour maximum concentration of $47.2 \mu\text{g}/\text{m}^3$ (table II-6). At Youngs Creek the geometric mean was approximately $9 \mu\text{g}/\text{m}^3$ with a 24 hour maximum of $50 \mu\text{g}/\text{m}^3$. Both sites are below the Federal standards of $75 \mu\text{g}/\text{m}^3$ annual geometric mean and $150 \mu\text{g}/\text{m}^3$ 24-hour maximum and Montana State guidelines of $75 \mu\text{g}/\text{m}^3$ annual geometric mean and $200 \mu\text{g}/\text{m}^3$ 24-hour maximum for both the annual geometric mean and the 24-hour maximum.

TABLE II-6.--Total suspended particulate (TSP, $\mu\text{g}/\text{m}^3$) and settled particulate (dustfall, tons/mi²/month) data characteristic of Spring Creek and vicinity

Site	Monitor	Period of record	Geom.	Arith.	Max.	Min.
Spring Cr.	TSP	05-18-76 to 02-12-77	21.1	---	47.2	---
Youngs Cr.	TSP	10-03-75 to 02-12-77	8.6	---	50.0	---
Decker	TSP	01-09-76 to 11-20-76	74.1	---	236.2	---
Youngs Cr.	Dustfall	9-74 to 1-76	---	5.71	9.51	0.51

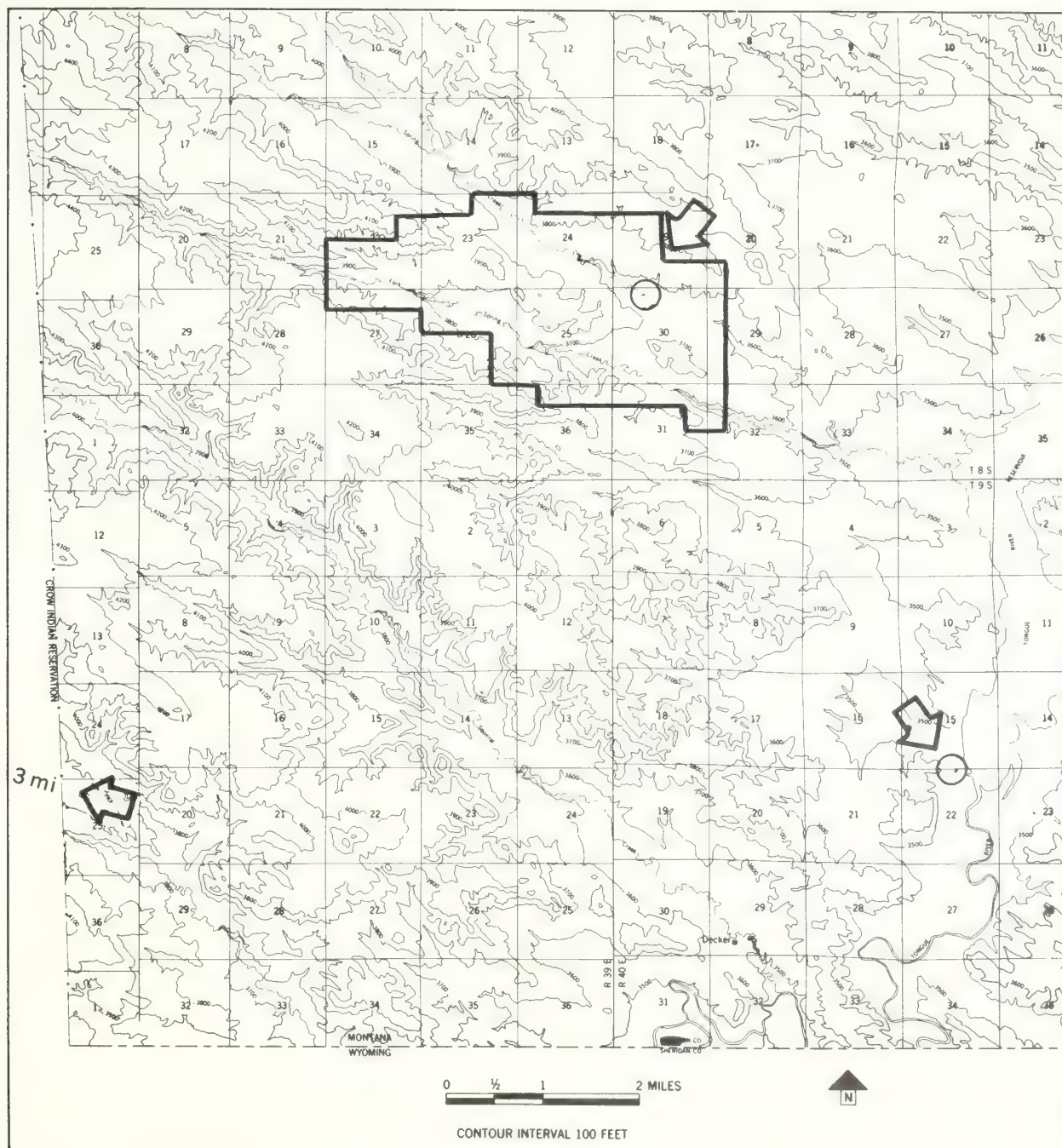


FIGURE II-8.--Air monitoring stations in the Spring Creek area.

Dustfall, a measure of "settleable particulates," was measured at Youngs Creek, a similarly undisturbed area. The average value recorded was 5.71 tons/mi²/mo. (the Montana residential standard is 15 tons/mi²/mo). These concentrations ranged from 9.51 tons/mi²/mo to 0.51 tons/mi²/mo. These values are low to average when compared to similar undisturbed sites in eastern Montana.

Concentration of gaseous emissions, such as sulfur dioxide (SO₂), nitrogen oxides (NO_x), and carbon monoxide (CO), at Spring Creek are unknown. Air quality studies from similar sites in eastern Montana report 24-hour maximum concentration ranges of 0.0 to 43.0 µg/m³ for SO₂ (Federal standard is 365 µg/m³ and State guideline is 260 µg/m³) and 0.0 to 19 µg/m³ for NO₂ (no standard) with annual arithmetic means ranging from 0.29 to 9.0 µg/m³ for SO₂ (Federal standard is 80 µg/m³ and State guideline is 52 µg/m³) and from 1.6 to 2.7 µg/m³ for NO₂ µg/m³ (Federal standard is 100 µg/m³) (EPA, 1975; Gelhaus, 1976). All concentrations at Spring Creek are assumed to be well within Federal standards and Montana State guidelines because of a lack of significant sources.

Visibility at Spring Creek is probably similar to that at Youngs Creek, usually about 35 miles. (See appendix D-2.)

The importance of additional baseline air quality parameters, such as particle-size distribution and chemical composition are discussed in chapter III.

E. SOILS

1. The Soil Resource

The soils in the Spring Creek area reflect the diversity of their parent materials, vegetation, topography, age, and, to a lesser degree, the influence of man's activities. Although the natural rates of erosion are high relative to more temperate areas, the soils have been in a state of semiequilibrium, in which apparent rates of soil formation compensate for erosion over the long term.

The diversity of soils in the permit area reflects the relative stability of the ecosystem as a whole. The soils have developed a range of chemical and physical characteristics, supporting a wide diversity of vegetation, and in turn, many forms of animal life. By contrast, uniform areas reclaimed after mining, such as those at West Decker and Colstrip, do not support the diverse life forms represented in the permit area.

Within the permit area, approximately 250 acres has been cultivated at some time in the past. In those formerly-cultivated areas, vegetation cover has been reduced and erosion rates increased, both by unknown amounts. Most of the remaining 4,170 acres within the permit area has

been impacted to a lesser, unquantified degree by overgrazing during the last 100 years. Recovery rates from overuse on old fields and pasture appear to be very slow.

Soils within the Spring Creek area are not well developed compared with soils formed in somewhat wetter areas. Soils series mapped within the Spring Creek area are included in three Orders: Aridisols, Mollisols, and Entisols. Subgroup classifications of soil series and complete profile descriptions are in appendices E-1 and E-2, respectively, and should be consulted along with the chemical and physical data in appendix E-3 to develop an accurate image of the soils in the permit area. Figure II-9 illustrates the location and distribution of the various series and associations mapped within the Spring Creek area. All information has been provided by the company and has been field checked and subsampled by soil scientists from the Montana Department of State Lands and the Northern Powder River Basin task force. Minor revisions are being prepared by the company's consultant.

The moderately well developed Aridisols include the Colbar, Corkim, and Kimlen Series and are characterized by moisture regimes marginal to aridic, which provide moisture at a time when the soil is warm (late spring, early summer). The "B" horizon is altered (cambic) but not otherwise developed. These soils are further characterized by accumulations of soluble salts below 30 inches, making this zone saline and unsuitable for reclamation use.

The Mollisols, less well developed than the Aridisols, include the Erlan and Sperlin Series. These soils are characterized by dark-colored surface horizons denoting accumulations of organic matter, and a cambic, or having the appearance of a cambic, "B" horizon.

Salt accumulation is variable in the Mollisols and appears to be at least partially dependent upon subsurface textures and slope position. Soils with coarser textures and higher rates of inflow will have deeper accumulations of salts than heavier, drier soils. (Compare Erlan and Sperlin electrical conductivity values and silt and clay percentages, appendix E-3.)

Entisols are noted principally for their lack of development. These include the Shinler, Travella, and Wiberg Series, as well as the otherwise undifferentiated alluvial soils. Maximum depth of development in these series is 12 inches and is limited to surface "A" horizons. The alluvial soils may include soils which could be classified as Mollisols. Based on available data and field observations, it is anticipated that Entisols would not be suitable to extensive salvage for reclamation purposes. There are several small areas in which upwards of 12 inches are available. The presence of bedrock near the surface is the principal limiting factor. Salt accumulations are concentrated below the soil profile in most cases. The alluvial soils may be an exception, but chemical and physical characteristics have not been submitted by the company for these soils.



FIGURE II-9.--Map showing soil series and associations.

2. Current and Potential Use

All of the Spring Creek area has been used for grazing in the recent past. At some time, there were attempts at both irrigated and dryland farming on approximately 250 acres, mostly Colbar and Kimlen soils, but these activities apparently were abandoned in the 1930's.

Soils in the area are capable of a more intensive use than has historically been the case, assuming high levels of management. Although the soils mapped by the company's consultant are not in the National Cooperative Soil Survey, efforts have been made to employ the Land Capability Classification System used by the Soil Conservation Service (SCS). This has been done by correlating the known characteristics of the soils with established series which have been classified into capability classes. Table II-7 details the soil mapping units by area and capability class (fig. II-10).

Capability Classes IIIe and IVe are considered potentially usable for crop production, with careful management. Approximately 1,965 acres (44.5 percent) of the area falls within these classes. Classes VIe and VIIe (46.4 percent), are best suited for grazing and wildlife with the exception of 350 acres (9.1 percent) of very steep and rocky terrain in Class VIIIe. These soils are designated as best used for wildlife, watersheds, and esthetic enjoyment.

F. VEGETATION

Vegetation in the Spring Creek area is representative of that in the breaklands and ephemeral stream courses throughout much of southeastern Montana. The species composition of this area typifies the western extension of the Northern Great Plains region, although species also occur in the Palouse Prairie or Great Basin regions. The occurrence and distribution of the flora reflect regional and local geologic and topographic features, and the resulting edaphic, climatic, and microclimatic conditions. Grazing, fire, and cultivation of the land have also influenced plant distribution. Appendixes F-1, F-2, and F-3, give the species list, community productivity, and community composition by increasers, decreasers, and invaders.

1. Vegetation Mosaic

Four growth forms (physiognomic categories) occur within the permit area: scrub, grassland, steppe, and forest. Each category is composed of certain vegetation types, and, in turn, each type is composed of certain vegetation communities. Eight vegetation types encompassing 16 vegetation communities exist within the permit area (table II-8 and fig. II-11). Communities are not haphazard in their distribution but, instead, are correlated with recurring combinations of environmental situations that tend to form a pattern or mosaic. Table II-9 shows the vegetation communities and the soils on which these communities occur.

TABLE II-7.--Land capability classes of soils mapped in the Spring Creek Permit Area, showing soil series, parent material and physiographic setting depth to bedrock, slopes, productivity before mining and areas covered by soil map units

Capability class ¹	Soils map unit ²	Soil series name and description (subgroup to which series belong)	Parent material and typical physiographic location	Depth to bedrock (inches) ³	Slopes (per-cent) ⁴	Total acres	Percentage of total acres	Remarks ⁵
IIIe	1	Colbar, fine, silty clay loam (Ustollic Camborthida)	Alluvium/colluvium on terraces & fans	66	1-4	254	5.7	Soils in Class III have severe limitations that reduce the choice of plants, or require special conservation, or both, when cultivated. They are suited for cultivated crops, pasture, range, and wildlife.
	11	Colbar-Kimlen; fine, clay loam (Ustollic Camborthids)	(As above)	42-66	1-4	600	13.6	
	3	Erlan; coarse, silty loam (Aridic Haplustolls)	Clinker and porcelanite footslopes below ridges	72	1-6	40	0.9	
IVe	4	Corkim; fine, silty loam (Ustollic Camborthids)	Alluvium/colluvium on terraces and fans	96	1-4	69	1.6	Soils in Class 4 have greater limitations and hazards than Class 3. Still more difficult or complex measures are needed when cultivated. They are suited for growing, cultivated crops, pasture, range, and wildlife.
	6	Kimlen-Colbar-Shinler; (Kimlen-Colbar same as 11 above) (Shinler same as 7 below)	Colluvium/alluvium on fans and terraces	40+20	5-10	559	12.6	
	2	Alluvial soils, loamy (Ustic Torrifluvents)	Alluvium in flood-plains	60	1-10 (variable)	207	4.7	
	8	Sperlin-Wiberg, coarse to silty loam (Ustic Torriorthents)	Clinker and porcelanite on ridges	20-40	3-8 (undulating)	236	5.3	
VIe	6A	Kimlen-Colbar-Shinler (as above)	Colluvium/alluvium/ and bedrock on dissected fans and terraces	0-60 0-66+	5-10+	167	3.8	Soils in Class 6 have severe limitations or hazards that make them unsuited for most cultivation. They are suited generally for pasture, range, woodland, and wildlife.
	7	Shinler; fine, silty clay loam (Ustic Torriorthents)	Sandstone, siltstone and shale in dissected fans, terraces and residual uplands	4-20 (shallow)	2-8+ (undulating)	178	4.0	
	13	Sperlin; coarse to fine silty loam (Ustic Torriorthents)	Clinker and porcelanite on ridges, stream divides	20-40	2-6 (undulating)	12	0.3	
	19	Travella-Shinler; (Travella Lithic Ustic Torriorthents) (Shinler same as 7 above)	Hard sandstone, siltstone and shale on ridge crests and broad upland surfaces	10-20	2-16	219	6.0	
	25D	Sperlin-Wiberg, coarse, fragmental, to fine, silty loam (Ustic Torriorthents)	(As above) on dissected and sloping terrain	(as above)	10-25 (rolling)	23	0.5	
	8D	Sperlin-Wiberg (same as 25D) (Ustic Torriorthents)	(As above)	(as above)	10-25	190	4.3	
VIIe	7D	Shinler; silty clay loam (Ustic Torriorthents)	Sandstone, siltstone, and shale on upland surfaces and dissected upland slopes	4-20 (shallow)	8-20 (rolling)	121	2.7	Soils in Class 7 have very severe limitations or hazards that make them generally unsuited for cultivation. They are suited for range, woodland, and wildlife.
	7E	Shinler; (as above)	(As above)	(as above)	20-50 (hilly)	381	8.6	
	27	Shinler; (as above) and shale outcrops (similar to 29, in Class VIII, below)	Sandstone, siltstone, and shale in steep, dissected slopes	0-20 (very shallow)	100+ (very steep)	554	12.5	
	9	Shinler-Wiberg; coarse, fragmental, "channery" loams (Ustic Torriorthents)	Sandstone, siltstone, shale, clinker, and porcelanite in dissected slopes and ridge tops	4-20 (shallow)	25-50 (hilly)	207	4.7	
VIIIe	29	Shinler and rock outcrop; (similar to unit 27 above)	Bedrock outcrops of sandstone, siltstone, and shale	0-20	60-100+ (very steep)	6	0.1	Soils and land forms in Class 8 have limitations and hazards that prevent their use for cultivated crops, pasture, range, or woodland. They may be used for recreation, wildlife, and water supply.
	20	Shale outcrop	Bedrock outcrop	0	60-100+ (very steep)	334	7.6	
	10	Terrace edges and escarpments (not classified as to capability but topographically best suited for wildlife and watershed)	Alluvium/colluvium and bedrock	—	50-100+ (steep and very steep)	63	1.4	

¹ Soil Conservation Service classification - capability classes III and IV have potential for use as cropland. Capability classes VI and VII are best suited for rangeland. Capability class VIII must be used only for wildlife or watersheds.

² Map units shown in figure II-9.

³ Depths are variable; typical averages or ranges are given.

⁴ The terms "undulating," "rolling," "hilly," and "very steep" are used in the map explanation, figure II-9.

⁵ The capability classification is a practical grouping of soils. Soils and climate are considered together as they influence use, management, and the kinds of crops that can be grown. Capability classes are also divided into subclasses. These show the principal kinds of problems involved. The subclasses are: "e" for erosion, "w" for wetness, "s" for shallow or stoney, and "c" for climate, short season, or drought conditions.

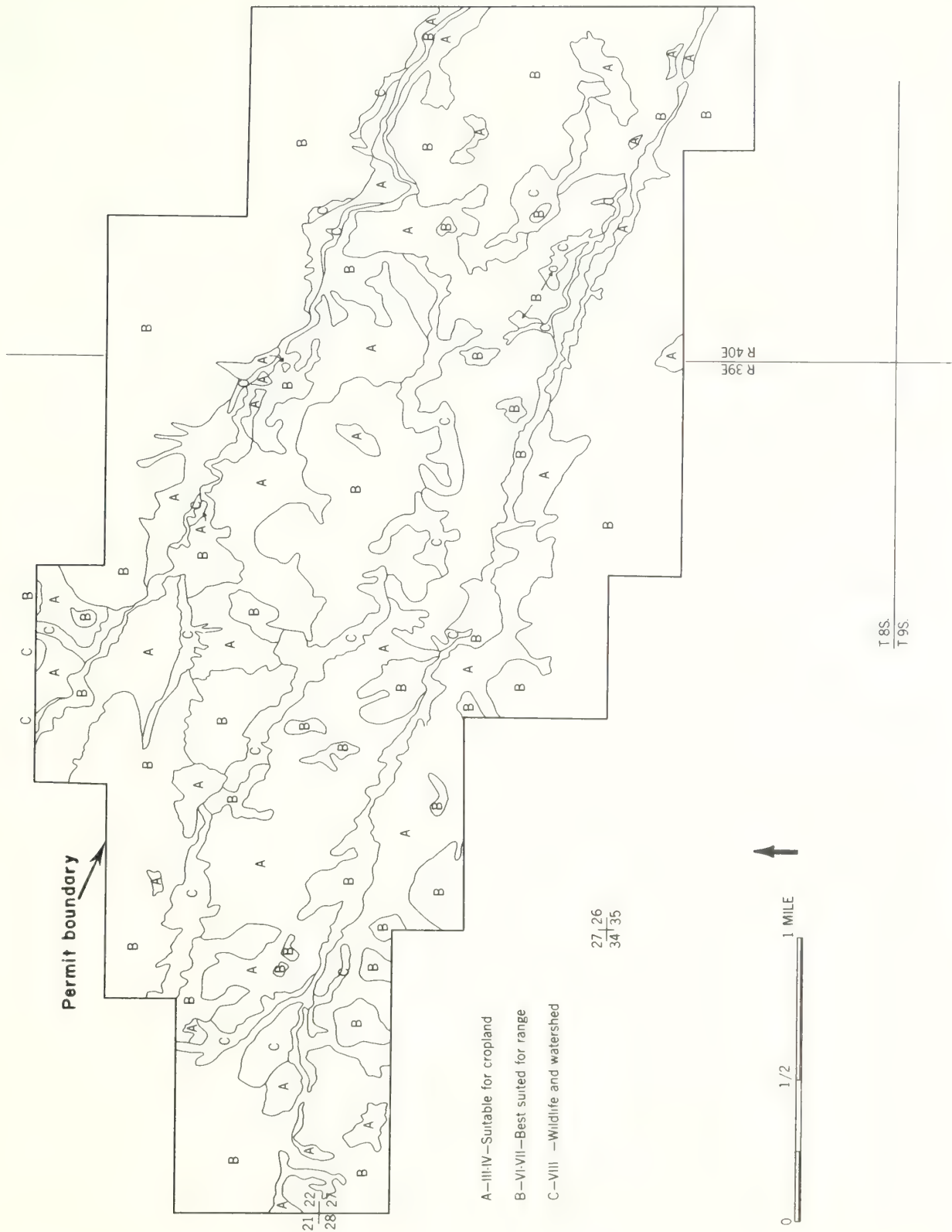


FIGURE II-10.--Map showing land capability classes.

TABLE II-8.--Physiognomic classes and associated vegetation communities of the Spring Creek area

Physiognomic class	Vegetation type ¹ (acreage)	Vegetation		
		Community	Acreage ²	Percent
Forest-----	Ponderosa pine/ juniper (146)	Ponderosa pine/juniper	³ 146	3
Scrub-----	Big sagebrush/ grassland (2,323)	Big sagebrush/mixed grass	2,126	48
		Big sagebrush and-thread	12	⁴ Tr.
		Big sagebrush/bluebunch wheatgrass	143	3
		Big sagebrush/western wheatgrass	42	1
	Silver sagebrush (137)	Silver sagebrush	137	3
	Riparian (16)	Riparian	16	Tr.
	Upland shrub (104)	Skunkbush	31	1
Grassland---	Grassland (984)	Shadscale saltbush	73	2
		Mixed grass	527	12
		Western wheat grass	48	1
		Needle-and-thread	16	Tr.
		Blue grama	4	Tr.
		Giant wildrye	8	Tr.
		Weed	381	9
Steppe-----	Grass/half-shrub/ forb (GHF) (854)	Grass/half-shrub/forb	854	19
Total-----			4,418	99

¹Vegetation types generally conform to the wildlife habitat types.

²Acreages are extrapolated from company data.

³The ponderosa pine/juniper community acreages are not computed in the total acreage figure.

⁴Tr. (trace) indicates communities that cover less than 1 percent.

⁵The GHF vegetation type is included in the wildlife grassland habitat type.

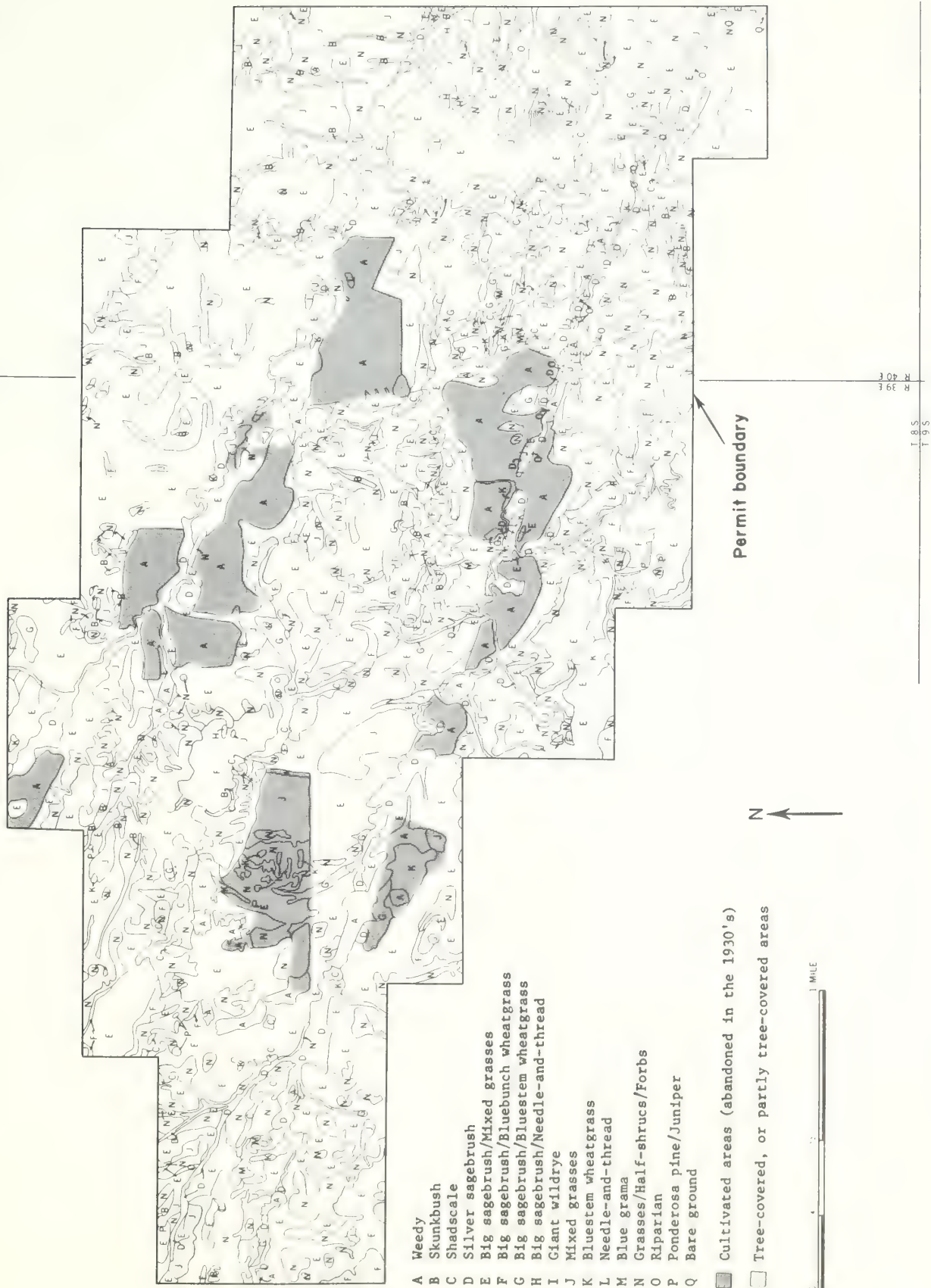


FIGURE II-11.--Map showing vegetation communities. (Permit application, Environmental Baseline Studies.)

TABLE II-9.-- Plant Communities and Associated Soils

Community	Soil series	Range of slopes (percent)	Map unit
Silver sagebrush	Miscellaneous	5-10	20
Ponderosa pine/ juniper	Shinler, Travella	2-50	9,19,27, 7E,20
Shadscale saltbush	Miscellaneous, Erlan, Sperlin	1-40	2,3,8D
Giant wildrye	Miscellaneous	1-4	2
Riparian	Colbar, Alluvial	1-10	11
Big sagebrush/ western wheatgrass	Colbar, Kimlen	1-10	1,6
Western wheatgrass	Colbar, Corkim, Kimlen, Sperlin	1-40	1,4,6,8D
Big sagebrush/ needle-and-thread	Erlan, Kimlen, Sperlin	1-40	3,8,6X
Needle-and-thread	Erlan, Kimlen, Sperlin	1-40	3,13,6X
Skunkbush	Erlan, Travella, Sperlin	1-40	3,19,8D
Blue grama	Kimlen, Travella	1-16	6,19
Weed	Colbar, Corkim, Erlan, Kimlen, Travella, Miscellaneous	1-16	1,11,6, 19,2,4, 10,6X,3
Grass/half-shrub/ forb	Colbar, Erlan, Kimlen, Shinler, Sperlin, Travella, Miscellaneous	1-50	9,6,7D,3,27, 1,8,6X,19, 7E,8D,20,25
Mixed Grass	Colbar, Erlan, Kimlen, Shinler, Sperlin, Travella, Miscellaneous	1-50	6,19,20,7, 25D,1,7D,8, 9,8D,7E,3,25
Big sagebrush/ mixed grass	Colbar, Erlan, Kimlen, Shinler, Sperlin, Travella, Miscellaneous	1-50	6,1,11, 27,19,2,8, 6X,3,8D
Big sagebrush/blue- bunch/wheatgrass	Colbar, Kimlen, Shinler, Sperlin, Travella	1-50	6,11,27,8D, 9,19,7E

a. Forests

Generally, the Spring Creek area is too dry for ponderosa pine. However, noncommercial stands of pine occupy steep, sheltered north slopes and canyons which have thin soils underlain by fractured bedrock. These sites receive additional moisture by runoff accumulation. The inclusion of Rocky Mountain juniper into the ponderosa pine/juniper community generally makes the pine distribution appear more widespread. Rocky Mountain juniper has a greater distribution; fire and grazing appear to be the major limiting factors, while depth of soil and precipitation are less important. Understories of the ponderosa pine/juniper community include several of the other community types which occupy the shallow upland soils.

Broadleaf deciduous trees in the permit area are sparse, occurring only along a short reach of South Fork Spring Creek where ground water in the alluvium is abundant. This forest type represents a small fraction of the more general riparian community.

b. Scrub

The scrub type includes eight diverse vegetation communities, all visually dominated by certain shrub species. Of these eight, five of the communities are dominated by evergreen shrubs (four big sagebrush communities and one silver sagebrush community), and three are dominated by winter deciduous shrubs (one skunkbush community; one shadscale saltbush community; and one riparian community including chokecherry, common snowberry, prairie rose, golden current and redshoot gooseberry). Over 40 percent of the area is covered by big sagebrush communities. Overgrazing has been the most important factor in the promotion of these communities. Fire and excessive soil moisture are antagonistic to big sagebrush communities. A recent fire has eliminated the big sagebrush in the NE1/4 sec. 29, T. 8 S., R. 39 E.; however, remnants of shrubs are evident. Alluvial floodplains generally are void of big sagebrush.

The silver sagebrush community occupies the alluvial flood plains and terraces where soil-moisture conditions are relatively good throughout the growing season. The dominant native grass within the community is western wheatgrass, although needle-and-thread is occasionally equally abundant.

Of the three deciduous shrub communities in the permit area, the skunkbush community is the most extensive. Skunkbush is primarily confined to shallow and bedrock soils in drier situations, that is, steep slopes with generally a south aspect. The predominant grass in this community is bluebunch wheatgrass, although needle-and-thread may be equally abundant. Skunkbush is an important browse species for mule deer; however, cattle also utilize much of the annual leader growth.

Shadscale saltbush is intermediate among the deciduous communities in terms of distribution. This community occupies steep slopes having shallow-to-bedrock soils and a saline and/or alkaline environment.

Moisture in these sites is generally low, thus reducing competition from many other species. This community has very wide-open canopy with as much as 90 percent bare ground. A sparse grass cover comprised mainly of bluebunch wheatgrass is found in the community.

The riparian community is very limited in the Spring Creek area. This community occupies the flood plains immediately adjacent to the ephemeral stream channels. Many of the shrub species and deciduous trees are utilized by wildlife for food, nesting areas, and shade. Giant wild rye is the dominant grass within this community.

c. Grassland

Five communities comprising the grassland type have histories of disturbances, generally from grazing. The communities reflect these disturbances by their distributions and species composition.

The most widespread of the five is the mixed-grass community. It is not associated with any particular soil type, slope, or aspect, and may actually represent the intergradation of several historically dissimilar communities (dominated by different grass species). This community, with the big sagebrush/mixed-grass community, accounts for over 60 percent of the vegetation cover in the Spring Creek area. Species diversity in the mixed grass community is quite high.

The western wheatgrass community has a limited distribution in the Spring Creek area primarily because of overgrazing. Where it occurs, this grass may be the predominant species.

Needle-and-thread grassland shows an affinity for moderately deep to deep soils. As for the western wheatgrass communities, present-day distributions of needle-and-thread dominated grasslands are very small.

Blue grama communities are heavily overgrazed as shown by the high ground cover of this species that increases with grazing. This community may be a remnant of other grasslands in which it appeared historically as a subdominant.

The giant wild rye community occurs primarily on the flood plain of South Fork close to the riparian community, although it may also occur in isolated instances in smaller valleys and on alluvial fans.

Although not a true grassland, the weed community has the appearance of grassland. This community, dominated by introduced annual and perennial grasses and forbs, was created by severe disturbance. One-third of the area encompassed by the weed community was at one time used for cultivated crops or as improved pasture. The remaining acreage in the weed community has been disturbed by intense grazing, trampling, and erosion. It is important to note that the weed community may serve as a seed source for weedy species which might invade reclaimed mining areas.

d. Steppe

The grass/half-shrub/forb community is confined to localized topo-edaphic¹ conditions, on the upland breaks and toe-slopes of hillsides. This community has the most diverse species composition of all communities and covers approximately 20 percent of the Spring Creek area. Within this community, bluebunch wheatgrass and needle-and-thread are the most abundant grass species.

2. Rare and Endangered Species

No known rare or endangered species are in the study area.

3. Noxious Weeds

Big Horn County and the State of Montana have designated 17 species in the county as noxious. Three species known to grow in the permit area, are Canada thistle, field morning-glory (or field bindweed), and wild licorice. Perennial sow thistle has been observed upstream from the permit area.

G. WILDLIFE

During 16 months of wildlife study, beginning in January 1976, four classes of vertebrate animals (mammals, birds, amphibians, and reptiles), consisting of 163 species, have been identified as utilizing a study area of about 100 square miles, including the permit application area, on either a year-round, seasonal, or migratory basis. Literature indicates that an additional 20 species, although not observed during the study, have ranges which overlap the study area. (See species list in appendix G-1.)

1. Habitat

Six general habitat types, each determined by physiognomically similar vegetation communities, or aspects of similar communities, have been identified in the Spring Creek area. The vegetative types delineated in the vegetation section delineate generalized wildlife habitat types. Table II-10 shows the wildlife habitat types and the estimated total acreage of each type.

2. Large Mammals

a. Antelope

The study area is an important winter habitat for antelope: groups of 100 or more animals have been seen during winter months. The size of

¹Topoedaphic is the combination of topographic and soil characteristics that help influence plant distribution and/or plant growth in a given area.

TABLE II-10.--Wildlife habitat in the Spring Creek permit area

Habitat type	Estimated acreage
Ponderosa pine/juniper-----	¹ 146
Sagebrush/grass-----	2,323
Grass-----	1,838
Silver sagebrush/riparian-----	153
Upland Shrub-----	104
Total-----	4,418

¹Estimated acreages for the ponderosa pine/juniper community are not included in the total acreage.

the antelope herds generally decreased from winter 1976 through spring 1977, as animals dispersed from the area of study. The number of animals then increased again as the does and kids began to congregate and were joined by bachelor herds. By January 1977 the permit area had a herd of 290 antelope.

Areas of major use by antelope are the flat, open habitats of sagebrush/grass and grassland that predominate in the northern half of the study area (fig. II-12). The fact that two-thirds of the total winter sightings in 1976 and 1977 occurred in these types of habitat demonstrates the importance of sagebrush/grass habitat, especially the sagebrush.

b. Mule deer

Herds of mule deer migrate within and through the Spring Creek study area, as indicated by seasonal fluctuations in animal populations (Biggins, 1976). Large herds of mule deer use the study area as a wintering site, and then may disperse 25-30 miles to the north and west during other seasons¹ (fig. II-13). The study area also serves as a year-round residence for smaller numbers of mule deer. The mule deer population on the study area reached a low point in the late spring-early summer of 1976 and then generally increased through the winter. This indicates that the proposed mine and surrounding area comprises habitat critical² to the local and migratory mule deer herd, especially in times of severe winter stress.

¹A high estimate of 388 mule deer was made during a single aerial flight in April 1977 (VTN, Inc., wildlife study in the area of the proposed Spring Creek mine).

²Use of the word "critical" is meant to convey biological importance and is not to be confused with the legal implication contained in Sec. 50-1042 of the Montana Strip and Underground Mine Reclamation Act.

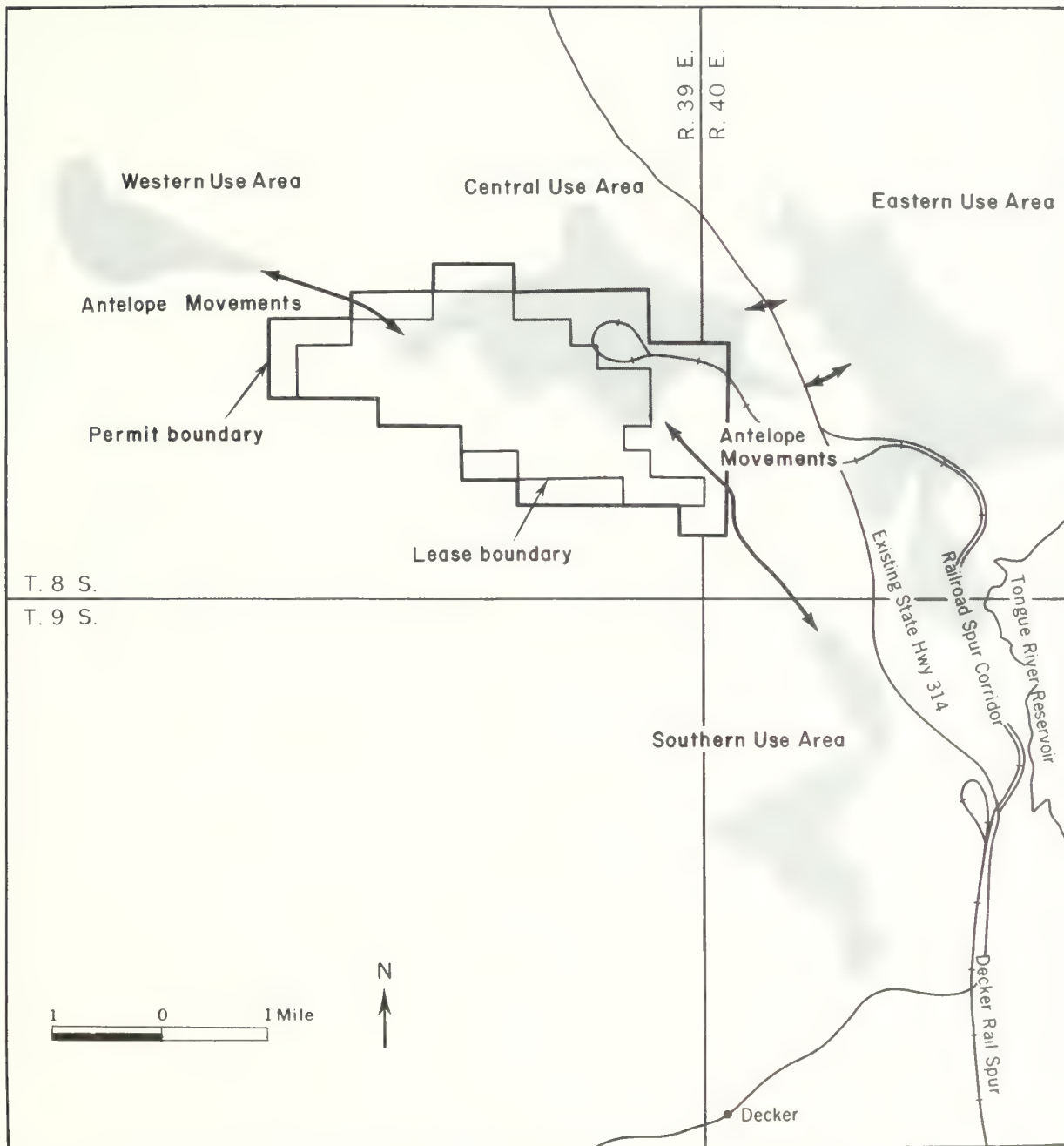


FIGURE II-12.--Major antelope use areas.

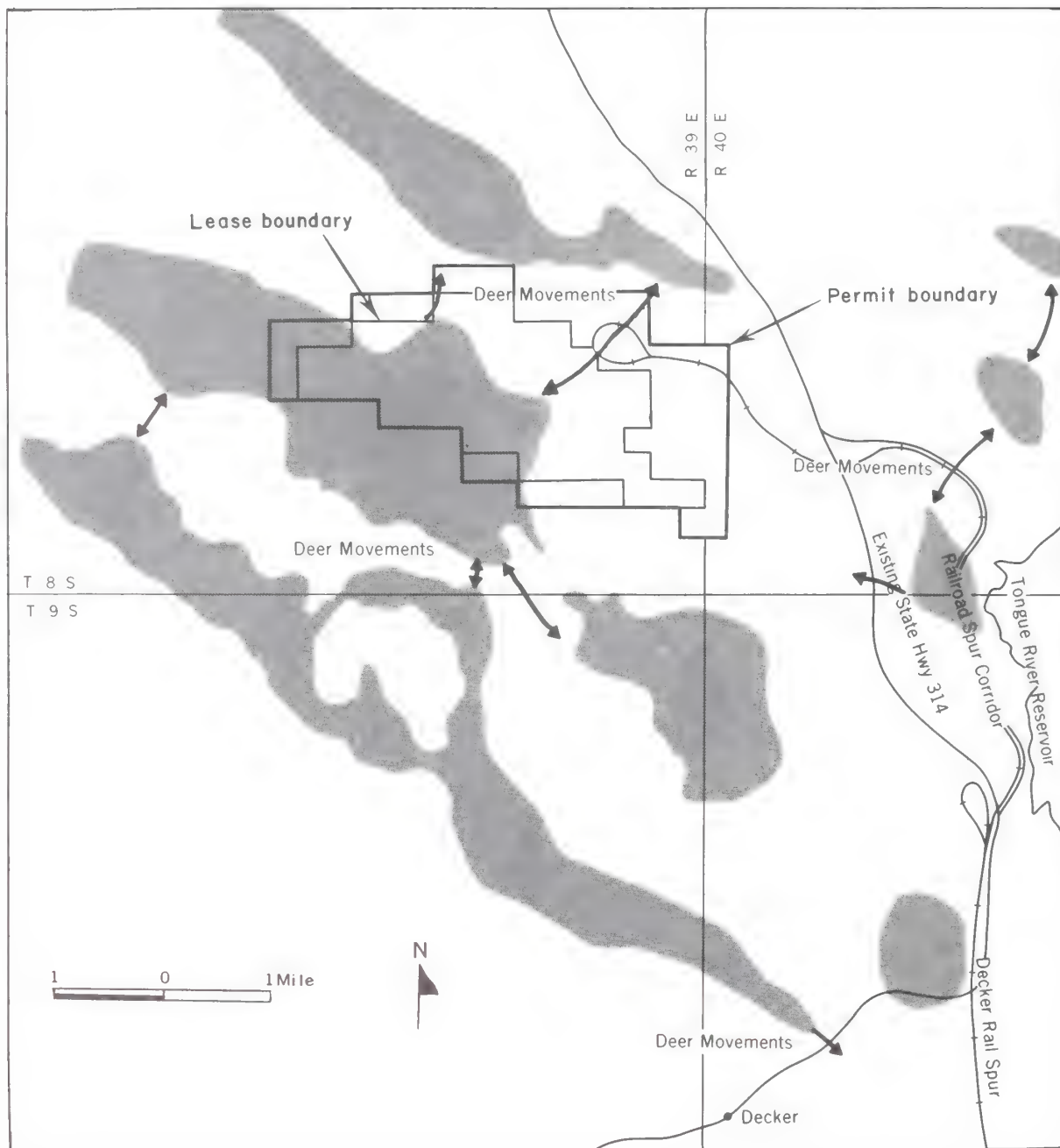


FIGURE II-13.--Major mule deer use areas.

Most mule deer observed during the study period were seen on the southern and western portions of the study area and on ponderosa pine/juniper covered ridges in the northern portion (fig. II-13). Mule deer occupy ponderosa pine/juniper habitats during the winter and summer months; however, during the winter-spring and summer-fall transition periods they use the sagebrush/grass habitat most frequently.

c. White-tailed deer

Observations indicate that very little of the study area is used by white-tailed deer. Most sightings have been made on the southern extremity of the Tongue River Reservoir and to the south of the permit area.

3. Other Mammals

Other mammals in the area include bobcat and coyote, rabbits, and small rodents. Bobcats were observed on the study area only twice by VTN personnel. At least four coyote families resided on the study area; family sizes varied with two, three, and four pups. Populations of coyotes and bobcats have undoubtedly been reduced by hunting and trapping.

The white-tailed jackrabbit has been sighted but is not abundant and, evidently, has no special affinity for a particular habitat type. Conversely, the desert cottontail is very abundant in the Spring Creek area and mainly utilizes the ponderosa pine/juniper and sagebrush/grass habitats.

Twelve species of rodents were sighted during VTN studies. Trapping of rodents revealed that the deer mouse population greatly exceeded all other small rodent populations. The most important habitat for small rodent populations was ponderosa pine/juniper, followed by areas containing sagebrush, while grass habitats appear to be least important.

4. Upland Game Birds

Sage grouse, the most commonly observed upland game bird, have three active breeding-display sites within the 100-mile study area (fig. II-14). The largest concentrations of sage grouse seen during display seasons of both 1976 and 1977 (28 and 35 birds, respectively) were at "Upper Divide" lek; smaller concentrations were observed at the "Windmill" lek.

The most important winter habitat for sage grouse within several miles of the mine area is probably near the western boundary of the permit area (fig. II-14). This area probably provides winter habitat for birds from both the "Upper Divide" and "Windmill" breeding-display areas. During fall and winter of 1976-77, groups of more than 100 birds frequented this area, with over 1,000 observations recorded in February 1977 alone. The sage grouse prefer sagebrush/grass habitat generally during the year but move to sagebrush of more dense cover in winter because of its better provision for cover and food.

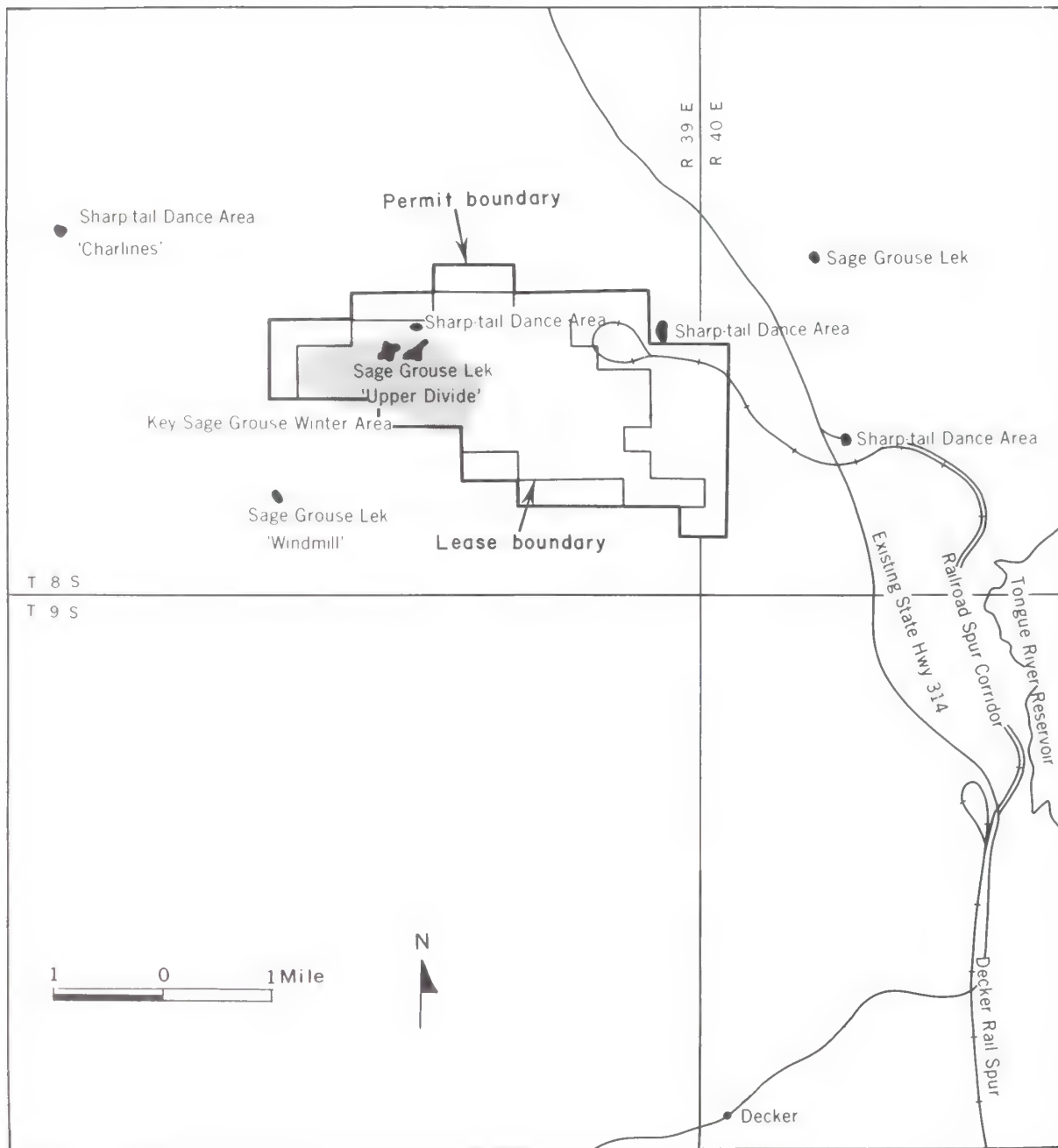


FIGURE II-14.--Grouse wintering and breeding areas.

The second most abundant game birds, sharp-tailed grouse, used five leks in or near the permit area. "Charline's" lek is the most heavily used of the display areas (fig. II-14). Winter habitat is dominantly sagebrush/grass. During the rest of the year primarily grass habitats are used, while the sagebrush/grass habitats are subordinate.

Gray partridge observations were scattered over the entire study area, primarily in the sagebrush/grass habitat and secondarily in the grass habitat. Large winter concentrations were noted in both habitats in January 1977.

Observations indicate that ring-necked pheasants are concentrated in the south and east edges of the study area, near the year-round water supply of the Tongue River.

5. Raptors

Nineteen species of raptorial birds were observed during the 16-month study. The golden eagle was the only species observed in all 16 months, although some red-tailed hawks, marsh hawks, prairie falcons, American kestrels, and great horned owls are known to reside in the area. Of the nine raptor species commonly observed during the spring and summer season, six are known to have nested in the permit area; the American kestrel being the most common (fig. II-15). The golden eagle nest, within the permit area and north of the railroad loop, was destroyed by high winds during the spring of 1977. The pair of eagles which used this nest established a new nesting site, outside the permit area, in the spring of 1978. The other eagle's nest, shown within the permit area, was determined to be a red-tailed hawk's nest by members of the U.S. Fish and Wildlife Service (appendix G-2).

Habitats most commonly used by raptors are sagebrush/grass and ponderosa pine/juniper. Of the total yearly observations, 30 percent occurred in sagebrush/grass habitat, and 27 percent in the ponderosa pine/juniper habitat. These habitats are also important to rodents, a primary food of the raptors. Conifers and deciduous trees and snags, and sandstone cliffs are of particular importance to all raptors for nesting and perching (J. M. Lockhart, oral communication, 1976).

6. Songbirds

The permit area has 62 known species of songbirds (appendix F-1), 39 of them summer residents, 14 migrants, 4 winter residents, and 2 year-round residents. Three species are undetermined but probably they are summer residents (the permit area is within their breeding range). The most abundant species is the meadowlark, a summer resident. The ponderosa pine/juniper habitat supported the most diverse bird populations, the silver sagebrush/riparian habitat the next, and the grass habitat the least.

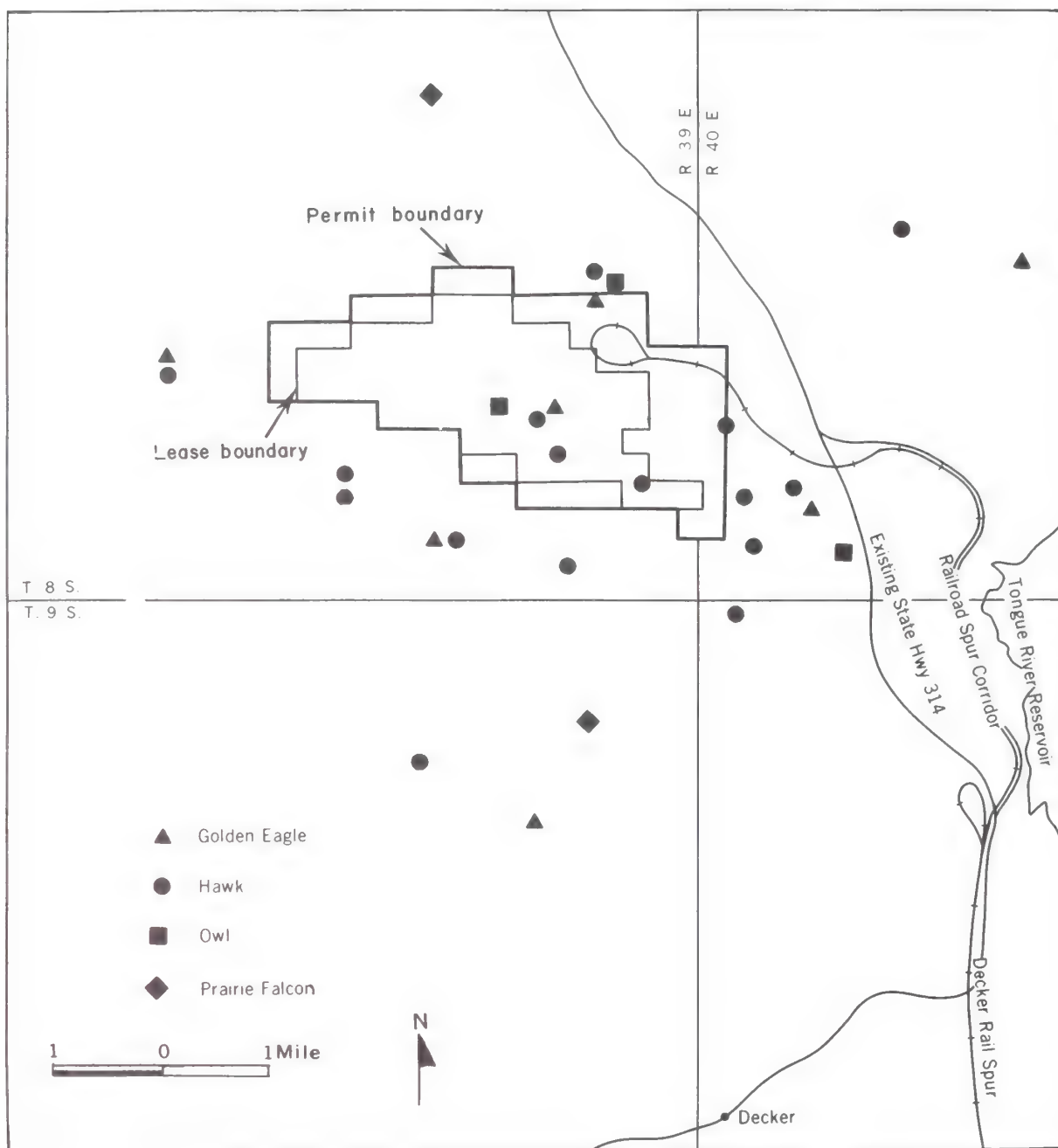


FIGURE II-15.--Raptor nest locations.

7. Amphibians and Reptiles

Thirteen species of amphibians and reptiles have been identified in the permit area, and another five species may be present. (See appendix F-1.)

The boreal chorus frog and the leopard frog, the most common amphibian species in the area, are restricted to the silver sagebrush/riparian habitat.

Of the six snake species identified in the permit area, the prairie rattlesnake was sighted most frequently. The prairie rattlesnake also had the widest distribution of the snake species, occurring in all five habitats. The bullsnake is the second most frequently sighted snake species and has been observed mainly in grass and sagebrush/grass habitats.

8. Endangered Species

The endangered Peregrine falcon was observed once during the VTN studies in the extreme southeastern portion of the study area--in a tree in riparian habitat along the Tongue River. Peregrine falcons are not known to nest within the study area. The only other species sighted within the study area was the bald eagle, which uses the area around the Tongue River Reservoir during the winter months.

9. Fisheries

Fish are not present within the permit area because of the ephemeral nature of Spring Creek and South Fork Spring Creek.

H. SOCIOLOGY

The Birney-Sheridan area comprises portions of Big Horn County, Montana, and Sheridan County, Wyoming (fig. I-2). The portion of Big Horn County in which the proposed Spring Creek mine would be located is known as the panhandle. It is separated from other non-Reservation parts of the county by the Crow Indian Reservation and the western half of the Northern Cheyenne Reservation, which are within Big Horn County. This part of the county is characterized by clustered ranch units that form natural rural communities and small villages. Such communities usually consist of a post office, a church or school, and a store or bar. It is anticipated that about 10 percent of the employees at the Spring Creek mine would live in Big Horn County.

The area of Sheridan County that would be most affected by population increases due to the presence of the Spring Creek mine would be the urbanized arc that begins at Dayton and extends eastward and southward through Ranchester to Sheridan, Wyoming. This region contains approximately 60 percent of the population of Sheridan County. It is anticipated that about 90 percent of the employees at the Spring Creek mine would live in

Sheridan County. Of this 90 percent, most would be expected to live in the town of Sheridan.

1. Population

Historically, the Birney-Sheridan area has experienced a number of boom-and-bust population cycles (fig. II-16; table II-11). The early cycles were related primarily to the cattle boom, the homesteading boom, and the oil and gas boom. The present era of strip mining, in this portion of Big Horn County, began in 1972 with the opening of the West Decker mine.

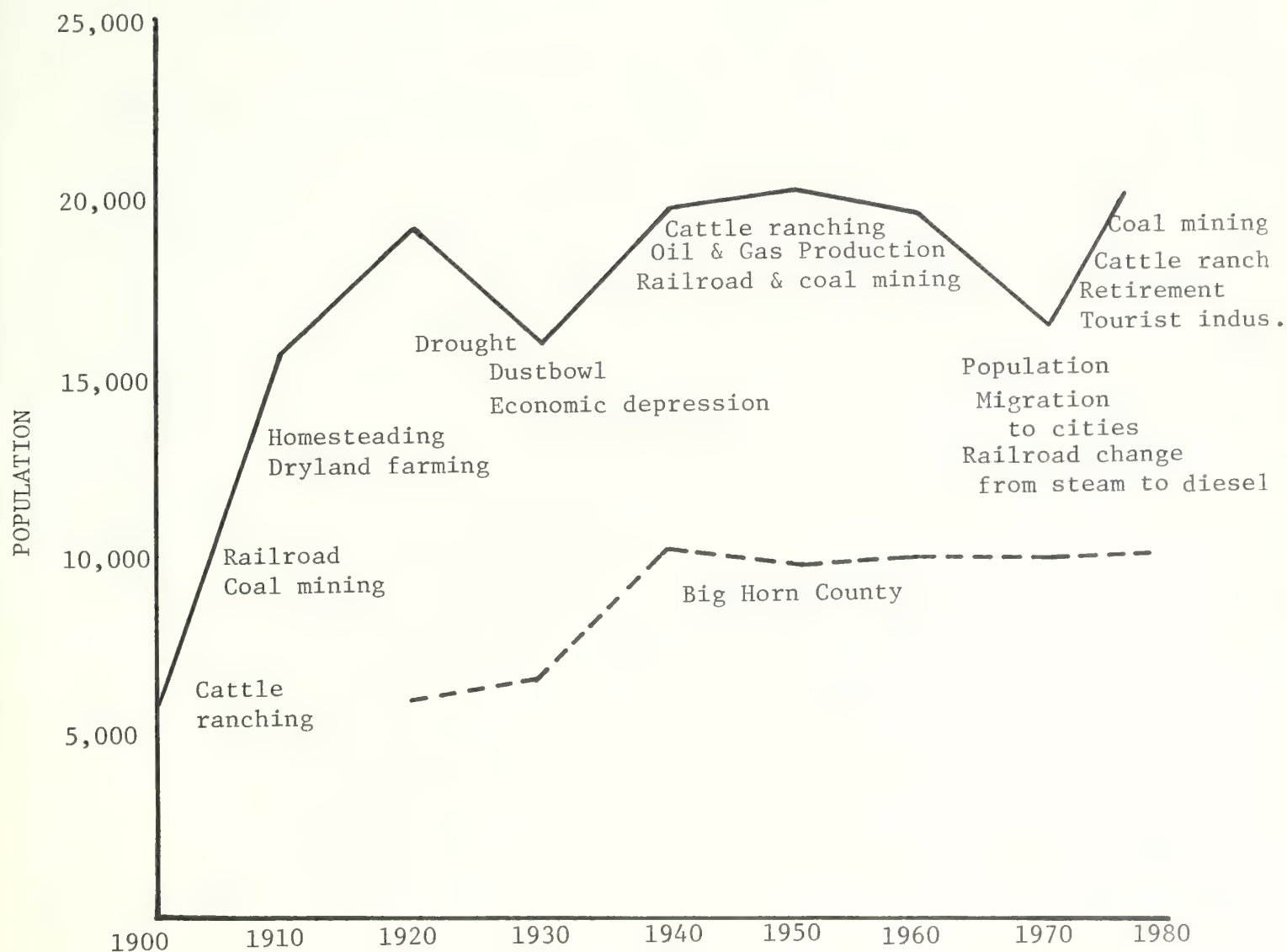
Between 1970 and 1976, Big Horn and Sheridan Counties grew by 5.6 percent and 17.0 percent, respectively (table II-11). These growth figures correspond to increasing coal-related activities in both counties. Mine development has caused a rapid population growth since 1970 for the towns of Sheridan (21.6 percent), Ranchester (+101.9 percent), and Dayton (+38.9 percent). Because of the proximity and access of this urbanized center to the mining area, the mine related population growth has occurred in the Sheridan urban area instead of the rural portions of Big Horn County.

The influx of newcomers appears to have been rapid enough (greater than 500/year since 1972) that they have not been able to assimilate smoothly into the local community. This has produced social changes and signs of social disorganization. The rural areas adjacent to the mining properities have also seen significant changes due to mining activities.

The populations of both Big Horn and Sheridan Counties are expected to show general increases even without the addition of the Spring Creek mine (table II-12). Regional migration trends, of which Big Horn and Sheridan are a part, indicate that net population in-migration will continue at least through 1990.

General population increases in Big Horn and Sheridan Counties are a direct reversal of population trends that existed from 30 years prior to 1970. Between 1940 to 1970 both counties lost people. The net out-migration for Big Horn County was 3.5 percent (10,419 to 10,057 people). Sheridan County lost about 7.3 percent of its population (19,255 to 17,852 people).

The net population out-migration in this area can be attributed to several factors. Agriculture during the period from 1940 to 1970 underwent a pronounced "mechanization period" in which labor was basically replaced, or substituted by fossil-fuel-powered machinery. Fewer people were needed to operate ranches and farms. Secondly, the deep-shaft coal mines in Sheridan County closed as a result of coal being replaced as a fuel by diesel, natural gas, and gasoline. Additionally, as the viability of many marginal and smaller ranches declined, neighbors would buy them to increase their own economic viability. Those who sold out generally bought better ranches in the area or left the area altogether.



Sheridan County was created in 1885; Big Horn County in 1913.

FIGURE II-16.--Population cycles in Sheridan and Big Horn Counties.

TABLE II-11.--Population change in Big Horn County and Sheridan County area

[Source: U.S. Census, Big Horn County Special Census 1976,
and Sheridan Area Planning Agency population study 1976]

Year	Big Horn County	Sheridan County	Region
1900-----	(¹)	5,122	(¹)
1910-----	(¹)	16,324	(¹)
Percent change-----	(¹)	+218.7	(¹)
1920-----	7,015	18,182	25,197
Percent change-----	(¹)	+11.4	(¹)
1930-----	8,543	16,875	25,148
Percent change-----	+21.8	-7.2	+0.88
1940-----	10,419	19,255	29,674
Percent change-----	+21.9	+14.1	+16.7
1950-----	9,824	20,185	30,009
Percent change-----	-5.7	+4.8	+1.1
1960-----	10,007	18,989	28,996
Percent change-----	+1.8	-5.9	-3.4
1970-----	10,057	17,852	27,909
Percent change-----	+0.5	-6.0	-3.7
1976-----	10,618	20,800	31,418
Percent change-----	+5.6	+17.0	+12.6
Percent change (1940-1970)-----	-3.5	-7.3	-5.9
Percent change (1940-1976)-----	+1.9	-8.0	+5.9

¹Not available, as Big Horn County was created out of parts of Rosebud and Yellowstone Counties in 1913.

TABLE II-12.--Projected population changes in Big Horn and Sheridan Counties and the towns of Hardin, Montana, and Sheridan, Wyoming, without the Spring Creek mine,¹ 1978-90

Year	County population		City population		County net migration ²	
	Big Horn	Sheridan	Hardin	Sheridan	Big Horn	Sheridan
1978--	10,609	22,487	2,858	15,734	134	313
1979--	10,600	22,369	2,849	15,616	-71	-248
1980--	10,694	22,720	2,943	15,967	33	221
1981--	10,985	23,067	3,234	16,314	228	215
1982--	11,160	23,439	3,409	16,686	111	239
1983--	11,341	23,841	3,590	17,088	116	265
1984--	11,533	24,272	3,782	17,519	127	293
1985--	11,733	24,729	3,982	17,976	133	316
1986--	11,975	25,285	4,224	18,532	174	413
1987--	12,222	25,863	4,471	19,110	177	432
1988--	12,474	26,468	4,723	19,715	181	454
1989--	12,729	27,092	4,978	20,339	183	471
1990--	13,491	28,814	5,740	22,061	688	1,564

¹This assumes that additional new activity is derived from existing mine expansion in the two-county area without new mining.

²Net migration is calculated from the number of people moving into the respective county less those moving out of the county.

With the advent of large scale strip mining and other fossil-fuel-related activities in Big Horn and Sheridan Counties in the early 1970's, population trends began to show a net increase. From 1970 to 1976, population grew from 17,852 to 20,800 people in Sheridan County. In Big Horn County the increase in population was not as significant as Sheridan's, but the population did grow from 10,057, in 1970, to 10,618 people by 1976.

Population projections for Big Horn and Sheridan Counties indicate a general increase from 1978 to 1990. If the Spring Creek mine is approved, the growth rate would increase; however, following the initial period of construction, in about 1981, there would probably be a short-term out-migration from both counties, as construction workers leave the area.

The population characteristics of Big Horn and Sheridan Counties significantly differ in racial composition (table II-13). Big Horn County has a large Indian population relative to Sheridan County. In 1970, 39 percent of Big Horn's total population was comprised of Indians living mostly on the Crow Reservation. In contrast, Sheridan County had a very small Indian population. Only 0.4 percent of Sheridan's total population was represented by American Indians. Although the baseline information used for this comparative racial analysis was established through the 1970 census, the general racial attributes of the population have not substantially changed in recent years.

2. Social Organization¹ and Ongoing Social Impacts

The social environment into which the proposed Spring Creek mine would be permitted is presently going through a period of rapid growth and social change. Although this growth and change could not be considered as "boomtown" (Gilmore, 1976), it is still in an unstable condition.

The society² that developed in the Birney-Sheridan area is the result of a process of social interactions and relationships that helped people to survive and develop a meaningful way of life. Cattle ranching and dryland farming were and still are the primary forms of agriculture. Many of the ranch and farm families of today are third and fourth generation. As a result of this agricultural base and varying environmental conditions, the pattern of land settlement was such that towns were small and neighbors were far apart. Roads and highways have developed, along with settlement patterns, in a way that has influenced social relationships.

The intervention of the new mining era has produced signs of strain and disorganization on this existing social organization. Both the rural and urban areas have seen significant social changes since the

¹Social organization refers to the relatively stable pattern of social relationships of individuals and subgroups within society.

²A "society" refers to a group of people who interact more with each other than they do with other individuals -- who cooperate with each other for the attainment of certain ends (Kluckhohn, 1974).

TABLE II-13.--1970 Population characteristics for Sheridan County, Wyoming, and Big Horn County, Montana, compared with State and national averages

[Source: U.S. Department of Commerce, 1970]

Characteristic	Big Horn County	State of Montana	Sheridan County	State of Wyoming	United States
Net migration (1960-1970)-----	-17.9	-8.6	-8.3	-11.9	1.7
Birth rates/ 1,000 (1969)-----	21.5	17.3	14.5	17.4	17.5
Death rates/ 1,000 (1969)-----	10.0	9.7	13.7	8.9	9.5
Racial characteristics					
White-----	60.0	95.7	99.0	97.5	87.5
Negro-----	---	0.3	0.2	0.7	11.1
Indian-----	39.0	3.8	0.4	1.5	0.4
Other-----	1.0	0.2	0.4	0.3	1.0
Household size-----	3.7	3.1	2.8	3.1	3.2
Education Attainment (Person 25 yrs old or older)					
Median years of school completed	11.2	12.3	12.3	12.4	12.1
Less than 5 years- 4 years of high	3.5	1.0	2.5	2.6	5.5
school or more--	44.4	17.9	60.4	62.9	52.3
4 years of college or more-	9.4	3.6	11.2	11.8	10.7

recent mining era began. Large numbers of newcomers have brought foreign styles of life, value systems, and different ways of earning their livings. Many long-term residents find these new lifestyles and population increases disturbingly different from their traditional way of life. The influx of newcomers has been rapid enough that they have not been able to be smoothly intergrated into local communities.

a. Big Horn County

Big Horn County is socially organized into natural rural communities which have been described by Gold (1975a). These communities represent the basic social and cultural arrangements of people in and around the mining area. (See figure II-17.) Existing mining activities are principally affecting the communities of Birney, Decker, Fourmile, and Kirby. The communities of Ashland and Quietus-Sayle are being affected by the present mining more indirectly. The size of ranches, continuity of families, status of strip mining, and community members' attitudes toward mining are important variables influencing the effects of strip mining on these natural rural communities.

There appears to be a correlation between ranch size and dependence on grazing permits. Ranches which are small in land area may have herds as large or larger than ranchers who own more land. Such operations are greatly dependent on grazing permits. Those with small deeded ranches tend to feel they are in an unstable situation around strip mining operations because the stripping, roads, railroads, and utility corridors could easily cut them off from the private or permit land they rely on. Those owning larger ranches also feel threatened, but some say they could live with mining if the coal is exported.

The continuity of families is an important part of members' attitudes and actions about strip mining. Third or fourth generation families are generally proud that they have been on the land that long. Through such families, the remnants of the earlier lifestyles of the cattle and homesteading eras are somewhat maintained. The memory of this kind of lifestyle is important.

There are actually two communities in the Decker area. One is bound tightly together by traditional family continuity; the other comprises first and second generation families who are more loosely bound to each other and the land.

Attitudes toward coal development are determined by people's perception of the effect coal mining will have on his or her community. According to Gold, people in 1975 were overwhelmingly opposed to strip mining. However, he noted that it was becoming more accepted. Those who support coal mining feel they can learn to live with it. They indicate that they've had it before and they can learn to live with it again.

At first, there seemed to be a resentment against those who sold or leased early; however, more people seem to be accepting the idea that mining is inevitable. They may have the attitude that "I may as well

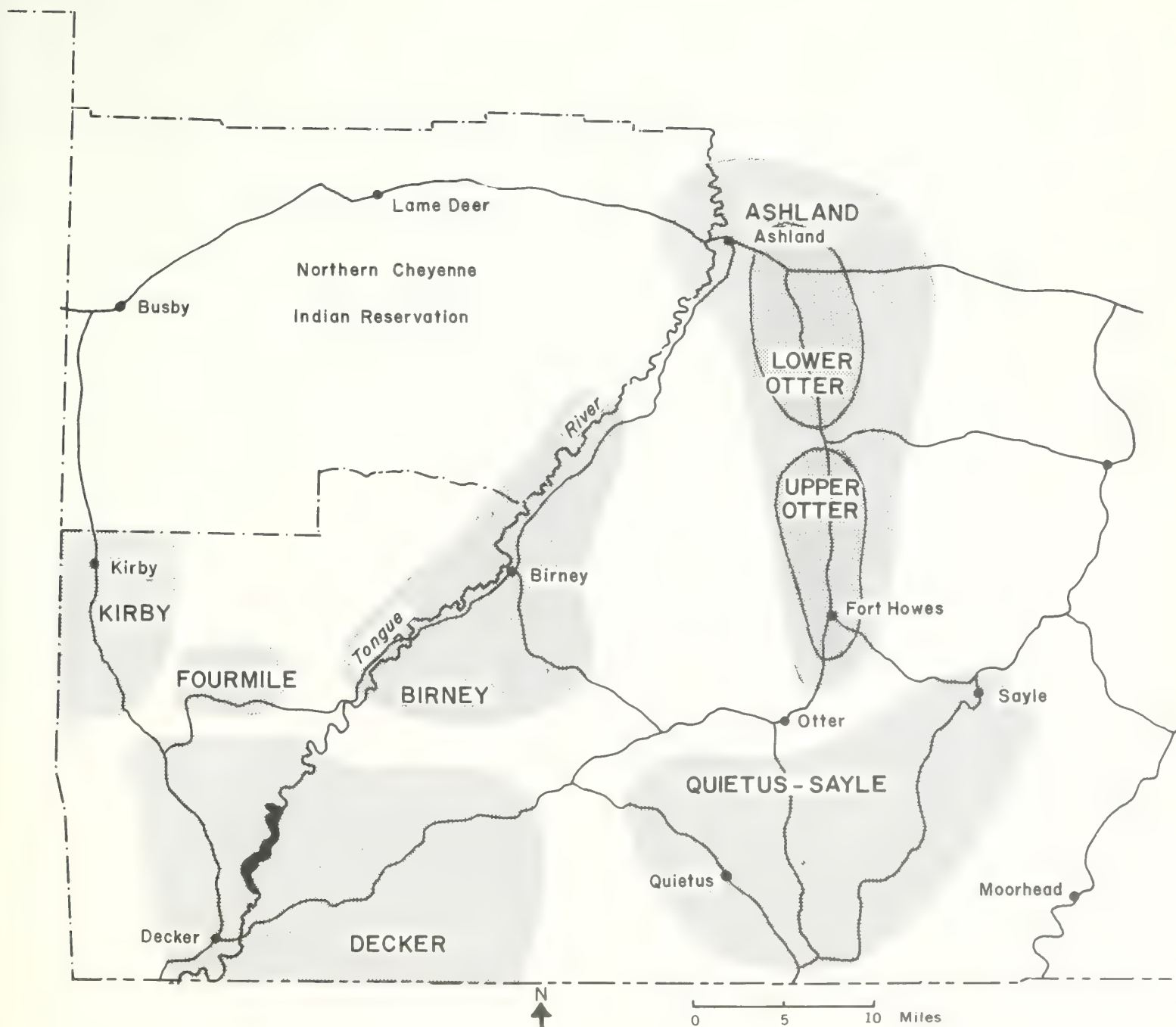


FIGURE II-17.--Natural rural communities, Big Horn County.
(Modified from Gold, 1975a.)

lease because my neighbor has and if they mine on his land they might as well mine here also" (Gold, 1974b).

Those in the Decker area seem to be the only ones who feel they have been abandoned to industrialization, according to Gold. Many around the Decker area feel that ranching is too marginal and that mining should therefore occur, especially if it gives the rancher enough money to buy a better ranch elsewhere. Many have sold and bought other ranches in the same area.

Those around Birney who support coal mining feel that it is provincial to oppose the opportunities and responsibilities that the new situation would bring. Opponents of mining contend that supporters have closed their eyes to social problems and have broken the traditional isolation of the Birney community. They also claim that supporters are unduly money-oriented and accept the reclamation claims of the coal companies without proof.

b. Sheridan County, Wyoming

Less is known about the social organization of Sheridan County, making it difficult to describe it with a level of detail similar to the description of the mining area in Big Horn County. Although mining is currently going on in Sheridan County, the impacts of population growth by Montana mines on the urban areas of Sheridan is of primary concern. It is anticipated that more information on Sheridan County will be incorporated into the final environmental statement.¹

Before the mine at Decker opened, the town of Sheridan was considered to be an attractive retirement community. This was illustrated by the presence of a large percentage of people over the age of 60. The community also served as a regional trade center for the rural areas of north-central Wyoming and extreme southeastern Montana. As mining and related activities increased in Montana, the corresponding increases in people were drawn to the Sheridan urban area. This was primarily the result of available housing, existing social and community services, the shopping district, professional services, and the lack of established towns close to the mines.

Gold (1975a) pointed out that the town of Sheridan has, to this point, benefited economically from growth, which has not been rapid or large enough to be very adverse. He pointed out that although people of Sheridan

¹Since the publication of the draft environmental statement, additional information on Sheridan County has been assembled under contract by the Institute for Policy Research, the University of Wyoming. Findings of that report are included in the analysis of the Central Field Mine Plan in chapter VIII. The full report is on file at the EIS task force offices in Billings and Helena, and at the Office of Environmental Impact Analysis, U.S. Geological Survey, Box 25046, Mail Stop 701, Federal Center, Denver, Colorado 80225.

have shown very little desire for the town to change from its current position as a regional shopping center, some people are hoping to benefit from new jobs and new money. From the time of Gold's study to the present, there has been a steadily increasing population of people seeking primary or secondary jobs created as a result of mining in the region.

Since 1975, impacts of increased growth have become noticeable in the form of crowded schools; increased housing costs and shortages; rising crime rates, welfare payments, and mental health problems; and strains in the delivery of community and health services. (See Community Services.)

I. ECONOMICS

1. Introduction

Traditionally, both counties were primarily agriculturally based with ranches forming small natural communities throughout the area. Ranches have historically been in families for generations. The city of Sheridan has been the regional marketing center for the study area along with being a retirement community. As a result of little or no economic growth for the past 50 years, prior to the 1970's, Sheridan's patterns were well developed.

Coal mining slowed to nearly nothing in the 1950's; however, its recent resurgence in the 1970's is impacting both Sheridan and Big Horn Counties. Mine developments have occurred primarily in Big Horn County; however, the associated population from the Montana mines has settled predominantly in the Sheridan urban area.

2. Employment

People in the two-county area have been dependent upon employment from the cities of Sheridan and Hardin¹ and from the agricultural base of the area. The majority of agricultural employment is derived from family-owned ranches who lease sizeable tracts of Federal land for grazing purposes.

Table II-14 depicts total employment (1975) in Big Horn and Sheridan Counties by sector, and shows comparative percentage contributions of the various sectors to total employment in both counties, in the States of Montana and Wyoming, and the United States. From this analysis, it is apparent that both farm proprietors' employment and farm salaried employment represent a larger portion of total employment than do those for the State of Montana, the State of Wyoming, and the United States. Government employment in the two-county area is also larger, and private nonfarm sector employment is smaller than for both States and the country. Due

¹Hardin, the county seat of Big Horn County, Montana, is peripheral to the regional study area, but it is the major source of population and employment for the county.

TABLE II-14.---Employment by sector for 1975 in Big Horn County and Sheridan County

[Source: Bureau of Economic Analysis, U.S. Department of Commerce]

Sector	Big Horn	Sheridan	Two County total	Percent of two		Percent of Montana		Percent of Wyoming		Percent of United States	
				total	total	total	total	total	total	total	total
Total Employment-----	4,035	8,843	12,878	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Farm proprietors-----	546	485	1,031	8.0	8.2	8.2	4.6	4.6	3.2	3.2	3.2
Non-farm proprietors---	388	1,048	1,436	11.2	10.1	10.1	8.7	8.7	7.3	7.3	7.3
Farm-----	474	358	843	6.4	4.0	4.0	3.2	3.2	1.2	1.2	1.2
Government-----	1,006	2,038	3,044	23.6	20.5	20.5	21.3	21.3	16.8	16.8	16.8
Private non-farm-----	1,621	4,914	6,535	50.8	57.0	57.0	62.1	62.1	71.5	71.5	71.5
Manufacturing-----	(1)	318	---	---	7.6	7.6	4.6	4.6	21.3	21.3	21.3
Mining-----	269	(1)	---	---	2.3	2.3	9.9	9.9	.7	.7	.7
Construction-----	177	700	877	6.8	4.3	4.3	7.9	7.9	4.2	4.2	4.2
TCU ² -----	113	364	477	3.7	6.0	6.0	7.0	7.0	5.0	5.0	5.0
Trade-----	31	1,803	1,834	14.2	18.2	18.2	17.1	17.1	18.2	18.2	18.2
FIRE ³ -----	82	251	333	2.6	3.0	3.0	2.5	2.5	4.5	4.5	4.5
Services-----	391	1,279	1,670	13.0	15.2	15.2	12.7	12.7	16.8	16.8	16.8
Other-----	(1)	(1)	---	---	.3	.3	.3	.3	.3	.3	.3

¹Deleted to prevent disclosure of confidential data²Transportation, communication, and public utilities³Finance, insurance, and real estate

to nondisclosure, the mining sector for the two counties cannot be determined using official government data.

Although the sectoral data in table II-14 are incomplete, construction and mining employment have increased since 1975. Currently, Decker Coal Company employs 335 people at its East and West Decker mine operations (Big Horn County). During 1976-77, with the construction of the East Decker mine, between 400 and 600 construction workers were temporarily employed. New mining activities have generated additional construction and wholesale/retail employment in and around the city of Sheridan. This impact of workers has been felt in Sheridan and at the Tongue River Reservoir, where many of them live in temporary quarters. Peter Kiewit Sons' Company employs 175 workers at its Big Horn mine. Most of this mining employment is new to the area since the early 1970's. Employees at the Decker mines are members of the Progressive Mine Workers and Operating Engineers Unions, while Big Horn mine employees belong to the United Mine Workers Union. Attempts have been made to have the Big Horn workers join the Progressive Mine Workers Union.

Table II-15 portrays unemployment rates for Sheridan and Big Horn Counties for the year 1970 thru the first quarter of 1977. Comparative figures for Wyoming and Montana, and the United States are also shown. Unemployment is higher in Big Horn County than in Sheridan County because of the large Indian population on the Crow and Northern Cheyenne Reservations. It is likely that many of the Indians in the area, faced with discrimination, poor education, and an absence of marketable skills in a non-Indian economy, have stopped looking for work and assumed that none is available to them. Historically, unemployment rates have been higher in Sheridan County than in other counties of Wyoming, because of the unavailability of jobs in Sheridan County through the last several decades.

TABLE II-15.--Unemployment rates in percentages*

[Source: U.S. Department of Labor, Bureau of Labor Statistics: Wyoming Employment Security Commission; Montana Employment Security Division, 1977]

	1970	1971	1972	1973	1974	1975	1976	1977
Sheridan County----	4.2	4.1	4.6	4.0	4.1	5.4	4.1	3.7
Wyoming-----	4.4	4.4	4.0	3.4	3.6	4.4	4.1	3.6
Big Horn County----	5.9	7.8	7.7	8.5	9.8	9.1	7.6	7.5
Montana-----	5.6	6.2	6.1	6.2	6.7	8.1	7.8	6.1
United States-----	4.9	5.9	5.6	4.9	5.6	8.5	7.7	8.2

*Table II-15 revised from draft.

3. Income

With the new mining activity, increased income is being realized by some people. These new payrolls have generated new forms of employment in the Sheridan area in terms of construction, wholesale/retail and service-related payrolls.

Based on data obtained from the Bureau of Economic Analysis, total wage and salary disbursements for the two counties increased by 32 percent between the years 1970 and 1975. Table II-16 depicts total wages and salaries for the two county area. Over the 5-year period, earnings in Sheridan County increased at a more rapid rate than in Big Horn County.

TABLE II-16.--Total personal income, 1970-75,
for Big Horn and Sheridan Counties

[Source: Bureau of Economic Analysis, U.S. Dept. of Commerce,
R.E.I.S. Program]

[thousands of dollars]

County	1970	1971	1972	1973	1974	1975
Big Horn--	\$40,853	\$34,651	\$45,516	\$56,459	\$53,758	\$51,268
Sheridan--	61,837	59,887	63,186	76,179	79,484	83,997
Total-----	\$102,690	\$94,538	\$108,702	\$132,638	\$133,242	\$135,265

Table II-17 shows per capita income between 1970 and 1975 for the two respective counties as well as comparative figures for the States of Montana and Wyoming. Per capita income in Sheridan County was higher than that for the State of Wyoming (\$6,204 in 1975) whereas Big Horn County was below the Montana annual average (\$4,482 in 1975). In addition, 1975 data reveal that per capita income for the State of Wyoming exceeds that for the State of Montana. The lower income of Indians in Big Horn County influences this lower per capita income. Table II-17 also indicates that income in Sheridan County, Wyoming, grew by a greater percentage than that in Big Horn County, Montana.

Table II-18 provides personal income by broad industrial sector for both counties for 1975. Also included are comparative percentage distributions of income by sector for the States of Montana and Wyoming, and the United States. Farm earnings (both farm proprietors' income and farm wage and salary earners) are more dominant in Big Horn County than in Sheridan County; although, in total, farm earnings (proprietors and wage and salary) represent nearly 15.3 percent of total income for the two county area.

TABLE II-17.--Per capita income 1970-75, Sheridan County, Wyoming, and Big Horn County, Montana; and States of Montana and Wyoming

[Source: Bureau of Economic Analysis, U.S. Department of Commerce, R.E.I.S.]

	1970	1971	1972	1973	1974	1975	Percentage change 1970-75
Big Horn---	\$3,132	\$2,948	\$3,541	\$4,302	\$4,456	\$4,482	43.1
Sheridan---	4,236	4,447	4,675	5,270	5,885	6,204	46.4
Montana----	3,500	3,576	4,070	4,784	5,079	5,433	55.2
Wyoming----	3,815	3,868	4,278	4,948	5,644	6,079	59.3

A unique characteristic of Sheridan County is that its service sector is quite large. Tourist and recreational activities, such as guest ranches, are seasonal and operate in the summer and fall, creating seasonal income that normally declines in the winter months. The service sector in Sheridan County, along with the wholesale/retail trade sector, represents nearly 30 percent of total earnings for the county. Other major sources of income in the two-county area are government income (21.2 percent) and wholesale/retail trade.

Economic analysis conducted in the area indicates that Big Horn County is a net exporter of agricultural and mining products. Nondisclosure law in Sheridan County does not allow such analysis; however, it is believed that Sheridan County is also a net exporter¹ of these products. Wholesale/retail trade and the construction sector in Sheridan County also reflect higher concentration than that of the U.S. The city of Sheridan is a regional trade center providing goods and services for northern Wyoming counties as well as for Big Horn and Rosebud Counties, Montana. Peter Kiewit Sons' regional offices are located in the city of Sheridan and provide sizable construction and mining employment in the two counties. The remaining sectors in Sheridan County are less concentrated than those in the United States. Coal extraction in Sheridan County is increasing with the operation of the Big Horn mine and with new coal mining activity occurring at the Acme mine. Together, the Decker and Big Horn mines promote substantial payrolls for the area.

Farm income is an important part of the two-county area. Sources of farm income are shown in table II-19 for the year 1970 through 1975. Between livestock and crops, livestock is the more dominant source of income in both counties, although in later years crops have become more dominant in Big Horn County. In 1975 livestock sales were comparable

¹This analysis was conducted using location quotients. Net exportation represents shipping out more produce than is being imported into the county.

TABLE II-18.--Sector earnings for 1975 in Big Horn County and Sheridan County

[Source: Bureau of Economic Analysis, U.S. Department of Commerce, R.E.I.S. Program. Data are in thousands of dollars]

Sector	Big Horn	Sheridan	Two County total	Percent of two County total	Percent of Montana total	Percent of Wyoming total	Percent of U.S. total
Total earnings-----	\$51,268	\$83,997	\$135,265	100.0	100.0	100.0	100.0
Other labor income-----	1,689	3,141	4,830	3.5	3.3	4.3	6.0
Proprietor's income-----	11,015	10,264	21,279	15.7	18.0	9.9	8.0
Farm income-----	7,758	160	7,918	5.9	11.0	1.1	3.0
Non-farm-----	3,257	10,104	13,361	9.8	7.0	8.8	5.0
Industry wage & salary---	38,564	70,592	109,156	80.7	78.7	85.8	86.0
Farm-----	10,379	2,192	12,571	9.4	12.7	2.8	3.0
Government-----	9,646	19,146	28,792	21.2	17.0	17.7	16.0
Federal-----	5,657	9,198	14,855	10.9	6.5	7.1	6.0
State and local-----	3,989	9,948	13,837	10.2	10.5	10.6	10.0
Private non-farm-----	18,539	49,254	67,793	50.1	49.0	65.3	67.0
Manufacturing-----	(1)	3,345	---	---	7.5	5.5	22.0
Mining-----	6,316	(1)	---	---	2.9	14.8	1.2
Construction-----	2,155	9,619	11,774	8.7	5.0	11.0	4.8
Trade-----	4,216	13,654	17,870	13.2	13.5	12.4	14.4
FIRE ² -----	753	3,066	3,819	2.8	2.8	2.6	4.6
TCU ³ -----	1,262	4,909	6,171	4.6	6.9	9.0	6.0
Services-----	2,953	10,894	13,847	10.2	10.4	9.7	13.8
Other-----	(1)	(1)	(1)	(1)	0.0	.3	.2

¹Deleted to prevent disclosure of confidential data.

²Finance, insurance, and real estate.

³Transportation, communications, and public utilities.

TABLE II-19.--Farm and ranch income 1970-75 (not adjusted for inflation)

[Data are in thousands of dollars. Source: U.S. Department of Commerce, R.E.I.S.]

	1970	1971	1972	1973	1974	1975
Big Horn County, Montana						
Total Cash Received	25,852	23,595	32,861	37,336	37,221	33,023
Livestock	16,879	18,075	24,344	23,120	17,135	16,638
Crops	4,864	2,650	4,797	9,101	15,082	11,234
Other Income						
Govt. Payments	2,147	1,435	1,321	794	120	309
Imp. Inc. & Rent	1,962	1,435	2,399	4,321	4,884	4,842
Change in Inv. Value	1,434	86	277	3,267	-541	325
Less: Production Exps.	<u>16,011</u>	<u>16,753</u>	<u>20,155</u>	<u>24,972</u>	<u>23,327</u>	<u>25,596</u>
Net Realized Income	9,841	6,842	12,706	12,364	11,894	7,427
Sheridan County, Wyoming						
Total Cash Recieved	15,700	17,174	21,630	25,692	20,745	21,808
Livestock	12,504	13,874	17,848	20,804	15,107	15,981
Crops	860	866	1,040	1,834	2,227	1,867
Other Income	2,336	2,434	2,742	3,054	3,411	3,960
Govt. Payments	386	334	398	226	50	126
Imp. Inc. & Rent	1,950	2,100	2,344	2,828	3,361	3,834
Change in Inv. Value	3,071	688	-283	340	1,379	-1,495
Less: Production Exps.	<u>13,043</u>	<u>14,218</u>	<u>16,507</u>	<u>19,088</u>	<u>19,727</u>	<u>20,154</u>
Net Realized Income	2,657	2,956	5,123	6,604	1,018	1,654

for the two counties. The data in table II-19 indicate the high degree of fluctuation in agricultural production and prices. Of the two counties, Big Horn has a greater agricultural income.

4. Tax Structure, Revenues, and Expenditures

The tax systems of Montana and Wyoming differ a great deal. Because of the variegated nature of the two systems, an economic analysis covering the two States is complicated by the spill-over effect of miners working in Montana and living in Sheridan County, Wyoming. The following tax analysis is an attempt to explain the tax system in order to help the reader understand the economic impacts on Big Horn and Sheridan Counties.

The following list portrays the general sources of tax revenue for the State of Montana:

General tax structure for Montana

- | | |
|---------------------------|----------------------------------|
| a. Property taxes | f. Tobacco taxes |
| b. Personal income tax | g. Insurance tax |
| c. Corporation income tax | h. Mineral resource taxes |
| d. Highway users tax | i. Inheritance tax |
| e. Alcoholic beverage tax | j. Unemployment compensation tax |

A special revenue policy for educational financing in Montana focuses on the general school budget, the foundation program permissive district levy, and other budget items. For purposes of financing highways, roads and streets, the State relies on fuel taxes, property taxes, special improvement taxes, vehicle registration, gross vehicle weight tax, coal severance tax, and Federal funds.¹ Currently, the property tax produces over 50 percent of State and local revenues, followed by the individual income tax, the motor fuel tax, the corporate license and the natural resource tax. Coal-related revenues will be an increasingly large percentage of total revenue received by school districts and county governments. Since expenditures depend on revenues, these institutions will become more dependent on income from coal mining.

The Montana tax system for State and county jurisdiction by type of tax and maximum mill limit, is presented in appendix I-1, table B. Tables C and D, of appendix I-1 present detailed accounts of tax levies, revenues, rates, and valuations of Big Horn County (1960-74). In general, those data show increased assessed valuations and decreasing tax levies, with time.

¹For more detailed information concerning Big Horn County and Montana taxes see appendix I-1 including table A.

The following taxes exist in Wyoming:

General tax structure for Wyoming

- | | |
|---------------------------|--------------------------|
| a. Property tax | g. Miscellaneous revenue |
| b. Sales and use tax | sources: |
| c. Highway user taxes | 1) Insurance company |
| and fees | taxes, |
| d. Natural resource- | 2) Inheritance and |
| based taxes | estate tax, |
| e. Alcoholic beverage tax | 3) Fish and Game license |
| f. Cigarette tax | and other fees and |
| | unemployment com- |
| | pensation tax. |

Additionally, Wyoming has special education-financing provisions including school levy, foundation program, and supplemental aid program. Highways and streets are financed through previously mentioned taxes but are supplemented by special improvement levies. Tax sources and distributions are made available in appendix I-1 (table E).

Sheridan County can rely on mineral production for only 17 percent of its tax base, whereas Wyoming counties on the average depend upon mineral production for 68 percent of the tax base. Still, historically, the assessed valuation for Sheridan County has been increasing: \$37.1 million in 1965, \$38.5 million in 1970, \$45.6 million in 1974, and \$57.7 million in 1978.

The city of Sheridan has also experienced increased assessed valuation, decreased mill levies, and only slightly increased taxes collected since 1970. (See appendix I-1, table F.) The specific analysis of funds for 1974 in the city of Sheridan indicates the general funds at a 7.4 mill rate accounted for 57 percent of the total \$228,978 revenues as indicated in appendix I, table F.

For the purpose of illustrating the mixture of taxes, the 1977-78 expected revenues of Sheridan and Sheridan County are shown in table II-20. From these data, a picture is easily seen of the relative dependence on the local tax base for various revenues.

It is important to note that the general funds in the various levels of local government do not provide a complete picture of the total tax account. A number of important funding functions are provided through separate funds other than general taxation. For example, in Sheridan an additional \$1.4 million is raised through the use of fees and grants for the water and sewer fund. In Sheridan County, \$0.64 million is raised for the hospital and \$0.36 million for the airport through taxation.

Data in table II-21 illustrate the increases in expenditures and revenues for the city of Sheridan between 1966 and 1975.

TABLE II-20.--Estimated revenue for Sheridan and Sheridan County, 1977-78

[Data are in thousands of dollars and in percent]

Source of revenue	City of Sheridan		Sheridan County	
	Revenues	Percent	Revenues	Percent
I. Property tax-----	\$163	7	\$324	11
Licenses, fees-----	534	22	95	3
II. Sales-----	770	31	491	17
Gasoline-----	180	7	138	5
Cigarette tax-----	160	7	10	--
Mineral royalties-----	115	5	317	11
III. Revenue-sharing-----	94	4	137	5
IV. Grants-----	284	12	959	33
Coal impact-----	--	--	150	5
Miscellaneous-----	125	5	234	10
Total, general fund (less cash on hand)---	\$2,445	100	\$2,855	100

Funding is raised within the local district, the county, and the State and is also received from the Federal Government. The primary source of school funding is the property tax. Six separate property tax levies can be assessed: State school, general county, county equalization, district qualifying, special district, bond, and interest. Of all property tax revenues raised in Wyoming, 75 percent are used for schools. Because approximately half the property tax base is accounted for by mineral revenues, there is wide variation in the capacity of school districts to support schools with assessed valuation.

As indicated in appendix I-1, table G, the two school districts being impacted in Sheridan County are poor, relative to other school districts in Wyoming. The State of Wyoming, however, has many prosperous school districts relative to national averages.

Property taxes account for only about half of school revenues. The remaining proportions are derived from various sources, including school lands income, oil royalties, motor vehicle registration fees, and general State appropriations. Most of these funds are placed in the State foundation program, for subsequent redistribution among the school districts. The source of funding for the school system, therefore, is quite diversified. Table H in appendix I-1 demonstrates the proportion of revenues, according to source, for the two potentially impacted school districts.

TABLE II-21.--Budgeted expenditures and estimated revenues for the city of Sheridan, Wyoming, fiscal years 1966 and 1975

[Data are in current dollars. Source: Budgets for the city of Sheridan]

	1966	1975	Percent Change 1966-75
	(\$000)	(\$000)	
Budgeted Expenditures			
General Fund, Total	710	1,742	145.4
General Government ^a	68	162	138.2
Police Department	101	230	127.7
Fire Department	87	170	95.4
Streets and Alleys	301	205	- 31.9
Public Health and Sanitation	66	158	139.4
Parks and Recreation	21	219	942.9
Federal Revenue Sharing	--	302	---
All Other	66	296	348.5
Bond Sinking and Interest Funds	57	167	193.0
Cash and Reserve Funds	0	24	---
Subtotal	767	1,933	152.0
Water and Sewer	2,233	653	- 70.8
Total, Budgeted Expenditures	3,000	2,586	- 13.8
Estimated Revenues			
Transfers from State ^b	119	465	290.8
Other Nontax Revenue ^c	247	773	212.9
Property Taxes ^d	167	218	30.5
Cash Available	234	477	103.8
Subtotal	767	1,933	152.0
Water and Sewer Revenue	2,233	653	- 70.8
Total, Estimated Revenue ^d	3,000	2,586	- 13.8

a Includes general government, city attorney, city clerk and treasurer, cemetary, municipal court, engineering department.

b From gas, sales, cigarette, and use (beginning in 1974) taxes.

c Includes Federal revenue sharing during 1975.

d Excludes Policemen's Pension Fund.

In terms of debt capacity, school district No. 1 has a fiscal crisis (Thompson, 1978) because its two new elementary schools have exhausted its bonding capacity. School district No. 2 has no present fiscal problems, because it includes the city of Sheridan, and the district's assessed valuation has increased commensurately with its expenses due to population increases. District No. 3 is not growing, and no impacts are expected there.

Tax summary - Each State within the impacted area has special provisions in terms of levies and mill rates, as well as special provisions, for intergovernmental flows to local units of government of the county, towns, and school districts.

In comparing Montana and Wyoming tax revenue systems, two differences are apparent. Wyoming has no personal income or corporate income tax structure, while Montana has no sales tax structure. However, there are numerous tax revenue systems which are common between Montana and Wyoming. Both States return funds to local levels of government, and the property tax is the major source of revenue for each State.

Municipal and county governments rely on an extensive array of revenue sources, including a considerable proportion of funding from other than the municipal level. The major categories are: (1) revenues derived directly from local sources, (2) revenues received as shared proportions together with State government, (3) revenues received as transfer payments from State or Federal Governments, (4) revenues received in the form of grants of categorical aid from State or Federal Governments.

In the first category, two basic kinds of funding can be identified: general property taxation; and a large number of use, service, license or penalty charges. The second category includes primarily such dividend revenues as sales tax, gasoline tax, and cigarette tax. In the third category, are general revenue sharing and the school foundation program (applicable to school districts). The fourth category includes a variety of grants-in-aid which can be categorized as primarily project grants or formula grants.

5. Economic Projections Without Spring Creek

Given the current economic activities in the two-county area, and given the known expansion of existing mining activity, it is estimated that some growth will occur in the area without the Spring Creek mine being established.

Table II-22 shows estimated projections of employment for the two counties between 1978 and 1990 without the Spring Creek mine.¹ As indicated, Sheridan

¹All estimates in this section were taken from the computer model Coal Town II, Montana State University, Bozeman, Mont. Site specifics have been analyzed in conjunction with the regional Northern Powder River Basin EIS.

TABLE II-22.--Projected mine and ancillary employment through 1990, without Spring Creek mine; Big Horn and Sheridan Counties¹

Year	Mine employment ²	Big Horn County			Sheridan County		
		Economic			Economic		
		base employment	ancillary employment	total employment	base employment	ancillary employment	total employment
1978-----	195	2,244	2,264	4,508	4,376	6,248	10,624
1979-----	153	2,202	2,346	4,548	4,167	6,366	10,533
1980-----	153	2,202	2,445	4,647	4,292	6,604	10,896
1981-----	210	2,259	2,573	4,832	4,316	6,832	11,147
1982-----	210	2,259	2,679	4,938	4,430	7,067	11,406
1983-----	210	2,259	2,783	5,042	4,364	7,312	11,676
1984-----	210	2,259	2,889	5,148	4,389	7,567	11,956
1985-----	210	2,259	2,996	5,255	4,415	7,833	12,248
1986-----	210	2,259	3,104	5,363	4,441	8,110	12,551
1987-----	210	2,259	3,213	5,472	4,468	8,402	12,870
1988-----	210	2,259	3,323	5,582	4,495	8,705	13,200
1989-----	210	2,259	3,434	5,693	4,523	9,020	13,542
1990-----	210	2,259	3,546	5,805	4,551	9,347	13,898

¹Table II-22 revised from draft.

²Mine employment includes mine construction workers and railroad workers. Economic base employment includes miners, agriculture, manufacturing, Federal Government, proprietors, and part of transportation workers. Ancillary employment includes all other workers. Mine employees are estimated by county of residence.

County is estimated to have a greater absolute growth rate in terms of total employment for the period. Much of the growth would occur in ancillary employment as a result of other new mining ventures.

State, county, and school revenues and expenditures are made available in appendix I-2. It is estimated that the economic base in Big Horn County would be sufficient enough to provide more than adequate revenues for governmental entities. Sheridan County, on the other hand, would experience "short falls," indicating that the tax bases for the county and the school districts would be insufficient. Services and facilities needed would not be totally adequate, given budget constraints. Estimates for the growth rate, in the number of students per county, is also made available in appendix I-2, given that the Spring Creek or other new mines are not established.

6. Severance Tax

The amount of severance tax generated in Big Horn County, without the Spring Creek mine, constitutes a large income for the State of Montana from Big Horn County. In 1978 approximately \$28 million will accrue to the State of Montana. By 1990, without the Spring Creek mine, the severance tax (due to other projected mining in the county) will generate approximately \$104 million. (Adjusted for future inflation via Chase Econometrics Model.)

7. Crow Economics

The 1970 census reported 1,686 American Indians and 4,814 whites at least 16 years old on the Crow Reservation or in Hardin. 39 percent of the American Indians and 58 percent of the whites were in the labor force. For census analysis, the labor force is defined as those 16 years old or older, employed or actively seeking work. Many of those not in the labor force are housewives, students, or are over 65 years old. If employment opportunities existed, a considerable number of those not presently in the labor force probably would accept work.

The March 1977 BIA Report of Labor Force on the Crow Reservation, using somewhat different definitions, reports a labor force of 1,755, over two and one-half times that reported by the U.S. Census. Employment rates were also much lower, with 773 or 44 percent employed, while unemployment rates were much higher, with 982 or 56 percent unemployed. Of the unemployed, 720 or 41 percent were actively seeking work (Planning Support Group, BIA, 1978).

Three-fourths (76 percent) of the employed tribal members worked for either the tribal or the Federal Government. Other important industries were: manufacturing (10 percent), construction (7 percent), private education (6 percent), and agriculture (5 percent). The smallest sources of employment were: Federal military (0.3 percent), mining (1.4 percent), and transportation, communication, and utilities (1.9 percent) (Crow Impact Study Office, 1977). Some tribal members are employed in existing coal mines adjacent to the reservation. Westmoreland Resources' Absaloka mine, which is on Crow "ceded land" and is

covered by a preferential employment agreement, is the only mine where significant numbers of tribal members are employed. In the absence of such an agreement, it is likely that fewer tribal members would have been employed at the Absaloka mine (Crow Impact Study Office, 1977, p. 72).

8. Northern Cheyenne Economics

The 1970 Census reported 1,274 Northern Cheyenne of at least 16 years of age; 52 percent or 667 of these were in the labor force, according to the census definition. If employment opportunities existed, a considerable number not presently in the labor force probably would accept work.

The April 1978 BIA Report of Labor Force on the Northern Cheyenne Reservation, using different definitions, reports a labor force of 1,338. The employment rate was higher than for the Crow people, with 733 (55 percent) employed. Unemployment was lower than for the Crows, with 605 (45 percent) not employed. 450 of those not employed (34 percent of the labor force) were actively seeking work (Northern Cheyenne Tribe, Career Development Program, 1978).

The majority of the employed Northern Cheyennes worked for either the tribal or Federal Government. Agriculture and education were also important employment sources. Few of the Northern Cheyenne (less than 2 percent) are employed in coal-related industries (Northern Cheyenne Air Quality Redesignation Report and Request, 1976).

J. COMMUNITY SERVICES

Community services in the Birney-Sheridan area are currently being impacted due to population growth and increased demand for services. Expansion of existing services and provision of new services is lagging behind demand.

1. Housing

In 1976 Sheridan County had 7,446 housing units (table II-23). The city of Sheridan contained 71 percent of these, Dayton had 3 percent, Ranchester 2 percent, and Clearmont 9 percent. Together, these four urban areas contained 77 percent of the units. In Sheridan, as in other rapid-growth communities, the price of housing has increased because of low vacancy rates, rapid increases in demand, a limited building construction capacity, and difficulties in obtaining financing. Housing in southern Big Horn County is virtually nonexistent. The area is rural, dotted with a few ranch homes.

The types of housing units found in the Sheridan area are shown in table II-24. Major emphasis is on single family dwellings and mobile homes. Figure II-18 shows the age distribution of housing units. Only 30.5 percent of the housing units are less than 25 years old and many units probably require major maintenance expenditures.

TABLE II-23.--Housing units in Big Horn County and Sheridan County,
1970 and 1976

Location	1970 ¹			1976 ²			Percent change, 1970-1976 ³		
	Occupied	Vacant	Total	Percent vacancy	Occupied	Vacant	Total	Percent vacancy	Percent vacancy
Big Horn Co.	2,664	204	2,868	7.1	3,125	345	3,470	9.9	
Hardin	920	70	990	33.8	1,154	102	1,256	8.1	39.4
Lodge Grass	188	19	207	9.1	158	25	183	13.6	-75.8
Other	1,556	115	1,671	6.8	1,813	218	2,031	10.7	49.4
Sheridan Co.	6,022	633	6,655	9.5	7,329	117	7,446	1.5	57.3
Sheridan	4,111	323	4,434	7.3	5,199	51	5,250	0.9	-84.2
Dayton	(5)	(5)	141	(5)	196	3	199	1.5	-86.7
Ranchester	(5)	(5)	674	(5)	150	2	152	1.3	(5)
Clearmont	(5)	(5)	650	(5)	65	1	66	1.5	(5)
Other ⁴	1,911	310	1,956	15.8	1,719	60	1,979	3.0	(5)
									-81.0
									-10.1
									-80.7
									1.1
									11.8
									-84.3
									18.4
									41.1
									105.4
									32.0
									-81.0

¹1970 census

²1976 special census

³Base year 1970

⁴Row and column data for 1970 for Sheridan County, Other does not total due to differing data availability.

The 1970 Percent vacancy for Other is therefore overstated, as is the Percent change, 1970-1976.

⁵Data not available

⁶Derived from 1970 census population - 2.8 per household

TABLE II-24.--Types of housing units in Sheridan area
(in percent of total)

[Source: Sheridan Area Planning Agency Housing Survey 1976]

	Single family	Duplex	3-4 plex	5 or more	Mobile
Sheridan area--- 1976	87.1	1.1	0.8	0.5	10.5
Sheridan area--- 1970	81.3	4.4	4.3	6.4	3.6
Wyoming----- 1970	74.3	6.1	4.5	6.1	9.0

Much of the vacant housing is substandard, and occasionally a high percentage of the substandard housing is occupied. Table II-25 shows housing conditions in Sheridan County.

The only low-income houses in existence at the present time are those covered by the 103 Farmers Home (FmHA) loans/subsidies on existing single-family dwellings. According to the FmHA Sheridan office, most houses under \$30,000 are in such poor condition that the agency cannot finance them. In 1976, of the people qualifying for a subsidy, only 30 loans could be made.

Housing construction has increased greatly in the last few years (fig. II-19). The number of units is understated, in that a single permit is issued for a four-plex. The number of mobile homes increased from 307 in 1970 to 785 in 1976, and to 885 in 1977--an increase of 288 percent in 7 years.

A study by the Department of Economic Planning and Development (DEPAD) indicates that 34 percent of all households are renters but that 60.3 percent of households in need of assistance are renters. Renters are especially vulnerable to the inflating housing market. A homeowner's payments will remain constant; only the taxation will reflect the boom. Rental rates, on the other hand, will rise with the demand.

Nearly 40 percent of the families in need of assistance are homeowners. Many of them probably are elderly. These families may face difficulty in meeting the rising tax burden and, in addition, may be unable to maintain their homes adequately. Of the elderly needing assistance, 80 percent live in substandard housing.

2. Water

a. Sheridan

Sheridan has a municipal water system serving the town and some areas beyond the city limits. The system is engineered to handle the present population and some growth. The treatment system can produce water at the rate of 15 million gallons per day (MGD) for short periods. A 1974 engineering study (Black and Veach) indicated the following deficiencies in the Sheridan water system:

Age of housing source: SAPA Housing Survey 1976

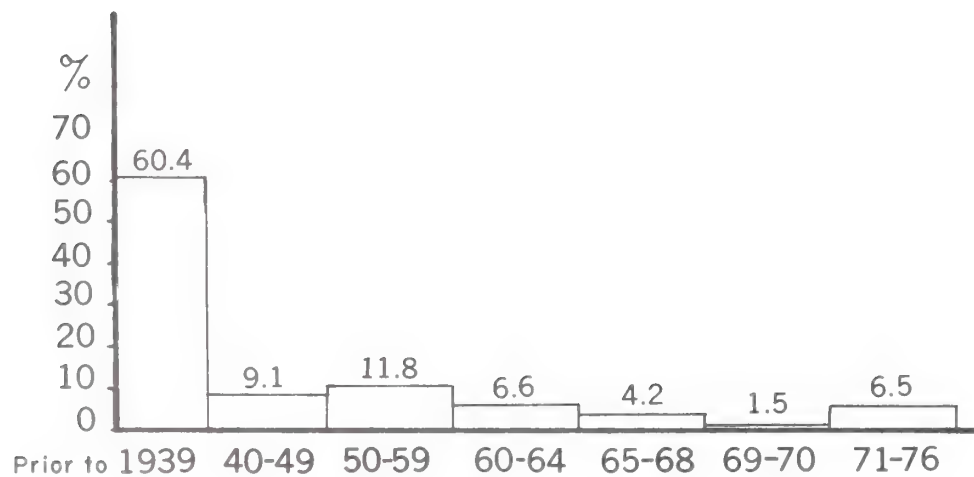


FIGURE II-18.--Ages of housing in Sheridan.

Building permits-Source: SAPA Housing Survey

Personal communication City Building Department					
1965	15	1969	17	1973	29
1966	47	1970	35	1974	40
1967	18	1971	38	1975	89
1968	23	1972	53	1976	112
August 1977 96					

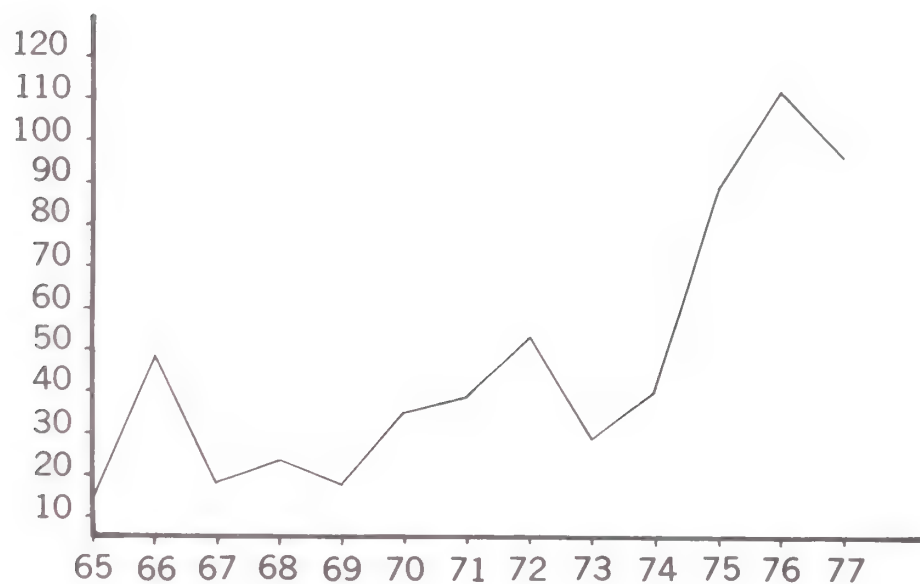


FIGURE II-19.--Building permits for new construction, Sheridan, 1965-77.

TABLE II-25.--Housing conditions in Sheridan County

[Source: Sheridan Area Planning Association (SAPA) 1976 Housing Survey]

	Total	Standard number ¹	Percent of row total	Substandard number ²	Percent of row total
County total-----	7,446	7,278	97.7	168	2.2
Occupied-----	7,329	7,754	98.9	75	1.0
Vacant-----	117	24	20.5	93	79.4
County rural total--	1,065	1,008	94.6	57	5.3
Occupied-----	1,014	1,000	98.6	14	1.3
Vacant-----	51	8	15.6	43	84.3
Sheridan total-----	5,250	5,180	98.6	70	1.3
Occupied-----	5,199	5,168	99.4	31	0.5
Vacant-----	51	12	23.5	39	76.4
Ranchester total----	152	147	96.7	5	3.2
Occupied-----	150	147	97.9	3	2.0
Vacant-----	2	0	0.0	2	100.0
Dayton total-----	199	194	97.4	5	2.5
Occupied-----	196	194	98.9	2	1.0
Vacant-----	3	0	0.0	3	100.0
Acme total-----	50	42	83.9	8	16.0
Occupied-----	49	42	85.7	7	14.2
Vacant-----	1	0	0.0	1	100.0

¹Standard includes mobile homes - standard or minor rehabilitation²Substandard - needing major rehabilitation or delapidated

- 1) Inadequate pressure in the NE. and NW. corners of town, and
- 2) Inadequate distribution in the north-central area.

The report indicated \$1.395 million for improvements including an additional 2 million gallon storage and several improvements in the distribution system.

Substantial growth would most likely outstrip the treatment capacity, first by raising the 8 MGD peak use to a level in excess of the 10 MGD capacity. Such growth would necessitate additional water rights and/or storage. At the average yearly use rate of 265 gallons per capita per day (gpcd) (3.5MGD/13,200), an additional 5,600 people would raise the average yearly consumption to 5 MGD, equaling the appropriation (table II-26). SAPA projections indicate this population occurring within 5-10 years.

Water system improvements were rated third most important in the Sheridan County Needs Survey (SAPA).

Table II-26 provides data for existing water systems in both Sheridan and Big Horn Counties.

b. Dayton

The town water system supply is considered adequate for existing and foreseeable uses. The treatment plant is generally adequate, with minor modification, except that the plant must meet EPA standards for filter backwash which will require a settling pond. The storage is inadequate to provide for peak demand, fire flow, and emergency reserve. The distribution system is undersized in several areas and there are an undetermined number of leaks which constitute a major problem. The system was designed for a population of 450. Current population is in excess of 500. Any major growth will place additional stress on the system, probably requiring major investment.

c. Ranchester

The town water system is under great stress due to rapidly increasing population. The supply and treatment are adequate except that the pumping capacity is too low. Only part of the storage is actually usable due to low pressure. Fire flow and domestic requirements indicate a need to triple the storage capacity. Portions of the distribution system are old, much of it is undersized, and the system needs engineering, e.g. looping of lines.

d. Rural

Other areas of the county rely on individual wells. It is difficult to obtain good water east of Sheridan due to poor chemical quality from coal aquifers. The major problem elsewhere is the possible contamination of wells by septic tank effluent. The County residents rated water improvements third out of 17 in the Sheridan County Needs Survey (SAPA).

TABLE II-26.--Existing water systems

[Sources: Big Horn County: Montana Department of Health and Environmental Science.
 Sheridan County: Sheridan Area Planning Agency (SAPA), Powder River Area-wide Planning Organization (PRAPO)]

	Present Population	Source	Appropriation MGD	Treatment cap MGD	Storage cap MGD	Distribution cap MGD	Av Sum Use MGD	Av Yr Use MGD	Peak Use MGD	Supply Presently Adeq.
Big Horn County										
Decker		private wells	-	-	-	-	-	-	-	Yes
Hardin	3,050		no filling	2.0	0.5	NA	NA	0.152	1.638	Yes
Lodge Grass		well 150 gpm .216 MGD	no filling	0.36	0.3	NA	0.05-.067	NA	NA	Yes
Sheridan County										
Sheridan	13,200	Big Goose Creek	5.0	10.0	6.0	15.0	NA	3.5	8.0	Yes
Dayton	500	Tongue	0.007	0.57	0.075	NA	NA	0.129	NA	Yes
Ranchester	416	Tongue	10.33	0.2	0.08	NA	NA	0.059	0.109	Yes

- Not applicable
 NA Not available

e. Decker

The area is served by private wells. Ground water is available from alluvium and coal seam aquifers. Generally, the upland water is of poor quality for human consumption. The coal aquifers or Tongue River alluvium are most commonly used for domestic use due to better quality. Some of these sources may meet Public Health standards for drinking water. The flows from existing wells indicate sufficient availability of water for additional domestic use if quality is sufficient.

3. Wastewater Treatment

a. Introduction

The exact state of adequacy of some sewage treatment facilities is rather difficult to describe. EPA standards required municipal treatment to be in effect by July of 1977. EPA has 75 percent matching money for construction of municipal treatment facilities. However, there has been a history of insufficient funding to implement the program. The Wyoming Department of Environmental Quality, which administers part of the EPA program, has taken the stand that the 1977 standards will not be enforced until EPA provides the money for facility construction. As a result, some towns are technically in violation. It is difficult to determine when the discharge standards will be enforced, but it is certain that at some time they will be.

A brief note is in order on the methods of waste treatment. Most small towns use a stabilization pond, or lagoon system. This type of treatment is inherently unable to consistently meet EPA 1977 standards. The systems are used because they are inexpensive, not because of effective treatment. The same problem of enforcement applies here also; at some time the 1977 standards will be enforced and facilities will have to meet them. In the mean time, towns will be allowed to continue existing operations.

b. Sheridan

The city operates a secondary treatment facility using a trickle filter process. The present system is inadequate. Using State standards for per capita flow, the system is capable of treating sewage for 12,500 people at the design capacity. The system peak capacity is 5.2 MGD but cannot be operated on this basis indefinitely.

The operator of the system reports that it is functioning well for all parameters except the removal of BOD (biological oxygen demand). This is considered a major problem by State and Federal water quality officials. PRAPO (Powder River Areawide Planning Organization) water quality monitoring indicates extremely high bacteriological levels below the plant discharge. Infiltration and inflow are a problem with the collection system which effectively reduces the treatment capacity.

Sewage treatment was rated fifth of 33 items in priority in the Sheridan County Needs Survey (SAPA).

c. Ranchester

The existing treatment system is inadequate. The present lagoon is substantially undersized. There is a substantial infiltration/inflow problem with the collection system. Standard per capita sewage flows range between 100-150 gpcd. Measurements taken on the system yielded flows equivalent to 736 gpcd. This excess water chokes the treatment system and reduces its effectiveness still further. There is apparently a problem with malfunctioning septic tanks on the north edge of town. The Needs Survey rated sewage improvements in the top three items. The PRAPO study recommended a three-cell aerated lagoon as the most cost-effective solution. Total construction cost would be about \$310,000.

The Comprehensive Plan indicates that the sewage treatment system of Dayton is generally considered adequate for existing and near future conditions. However, the 1 acre/100 people standard rule indicates that it is significantly undersized. The existing system does not discharge. Analysis indicates that after accounting for evaporation, more than two-thirds of the flow is seeping out of the lagoons. The town could be required to either seal the ponds or conduct an extensive monitoring program to determine the effect of the seepage on the ground water.

The collection system is fairly new and is in good shape. This type of treatment facility is unable to consistently meet discharge standards. The PRAPO study indicates the most cost-effective method would be to construct a three-cell aerated lagoon at a total construction cost of \$260,500.

d. Sheridan and Big Horn Counties

The unincorporated areas of Sheridan and Big Horn Counties are served by individual septic systems. Without codes and a permit system, many systems may be improperly designed, installed, or operated. A substantial risk is present in the potential contamination of water and the surfacing of untreated sewage. Seventy percent of the Sheridan County residents indicated a need for improved facilities. Table II-27, although somewhat incomplete, covers the various kinds of sewage systems in both Big Horn and Sheridan Counties.

4. Solid Waste

a. Sheridan

The city of Sheridan has a sanitary landfill of 56 acres which is also available to rural residents. The Sanitation Department estimates that the site will last up to 10 years at the present rate. The site and equipment are considered adequate for at least the short term.

TABLE II-27.--Existing sewage systems

[Sources: Big Horn County: Montana Department of Health and Environmental Sciences. Sheridan County: Sheridan Area Planning Agency (SAPA), Powder River Areawide Organization (PRAPO)]

	Present Population	Type of System	Treatment Capacity (MGD)	Collection Systems Capacity (MGD)	Peak Treatment flow (MGD)	Average Flow (MGD)	Number of cells	Acreage of cells	Discharge
Big Horn Co.									
Decker	NA	Septic Tanks	-	-	-	-	-	-	-
Hardin	3,050	Municipal	0.249	NA	0.425	0.30	2	NA	Big Horn River
Lodge Grass	NA	Municipal	0.08	NA	NA	0.08	2	11	Little Big Horn River
Sheridan Co.									
Sheridan	15,200	Municipal	NA	NA	4.0	2.0	(Secondary treatment)		Big Goose Creek
Dayton	500	Municipal	NA	NA	NA	0.032	2	25	Tongue River
Ranchester	416	Municipal	0.0465	NA	NA	0.25	2	3.2	Tongue River

b. Sheridan County

The county does not have a landfill. Rural residents either use municipal landfills or traditional dumps. The comprehensive plan suggests a multicounty management study and the possibility of remote areas being served by a joint facility rather than one per county.

The towns of Ranchester and Dayton both had landfills which have been closed. This is probably due in part to new standards which took effect recently. The towns now haul to the Sheridan landfill. Neither town has filed an application for a landfill permit, which suggests that there are no plans to open or reopen either site.

c. Big Horn County

The Decker area has been using an unlicensed dump; however, a tri-county solid waste management operation now covers the area, funded by a Montana Coal Board grant of \$289,859 made in February 1978. Dumping must now meet State licensing regulations.

5. Schools

a. Sheridan County

Three unified school districts serve Sheridan County. District 2, which includes the city of Sheridan, has received the greatest increase in enrollment. District 1, including Ranchester and Dayton, is also experiencing growth. District 3, on the eastern side of the county, is not having overloading problems but is plagued with deteriorating structures. This district is not expected to receive any impact from the Spring Creek mine and will not be discussed further.

1) District 1

Table II-28 shows the basic statistics for the district for 1976. Since then, approximately 60 new students have been added and the total number of teachers increased to 54. Many of these teachers have been hired for new programs, such as learning disabilities, or expanded programs such as kindergarten.

The district expected to break ground in November 1977 on two new elementary schools at the towns of Big Horn and Ranchester. These schools are seen as the most urgent need. There are many other needs and problems in the other schools. Junior-Senior High School in Dayton has reached capacity and needs space. The Big Horn School needs work done, such as a new furnace and wiring. The elementary school in Ranchester needs structural work, wiring, and space. The community hall in Dayton is being leased for the second grade. In short, the district is in great need of money for capital construction.

The two new elementary schools are costing more than the allowable bonding capacity of the district. Of the \$1.35 million needed, only

TABLE II-28.--1976 school statistics for Big Horn County, Montana, and Sheridan County, Wyoming

	Class room	Gym	Multi- purpose	Enrollment	Teachers	Student/ Classroom Ratio	Student/ Teacher Ratio	Expansion Program	Notes
Big Horn County									
Hardin									
High School 9-12	22		yes	551	33.0	25.0	16.6	yes	remodel and addition
Jr. High School 7-8	14			275	19.5	19.6	14.1	yes	new junior high school
Intermediate 4-6	13		yes	236	16.0	18.1	14.7	yes	remodel and addition
Primary 1-3	17			402	18.0	23.6	22.3	yes	remodel and addition
Crow Agency K-6	14	recreation		235	23.0	16.7	10.2	yes	remodel and addition
Fort Smith K-6 Lodge Grass	8	recreation		75	7.0	9.3	10.7	no	out of study area
High School 9-12	17		yes	153	17.2	9.0	8.8	yes	new high school
Elementary K-8	17	in high school		339	27.8	19.9	12.1	yes	take old H.S. for 4-8 renovate existing building
Wyola									
Elementary K-8	11	yes		96	14.0	8.7	6.8	no	
High School 9-12	17	in elem.		56	6.5	9.3	8.6	yes	new high school '78
5 Rural Elementary K-8	11	3Y 2N		141	12.5	12.8	11.2	no	1 out of study area
Sheridan County									
School District 1									
Big Horn K-12	20	yes		279	23	13.9	12.2		fair condition
Dayton 7-12	13	yes		206	23	12.9	12.2		good condition
Slack 1-5	1			9	1	9.0	9.0		fair condition
Ranchester K-6	8			186	9	23.2	20.6		poor condition
School District 2									
Sheridan Sr. 9-12	48	yes	yes	1,126	60.6	23.4	18.6		parts are delapidated to good condition
Central Jr. 7-8	18	yes	yes	420	19.2	23.3	21.9		parts are good to deteriorated
8 Elementary K-8	76	5	7	1,783	76.4	23.4	23.3		3 delapidated 3 deteriorated 2 good condition good condition
Special Education Special Services									
School District 3	7			72	6	10.2	12		
	7				10.9				
Clearmont K-12									
Arvada K-6	13	yes		125	13	9.6	9		poor condition
Parochial School 1-8	2			19	2	9.5	10		poor condition
	10	yes		223	10	22.3	23		excellent to good

\$945,000 can be bonded. The district has received a public works grant from the Federal Government for \$100,000 and is selling land for \$80,000. The remaining difference is still unavailable. The board is planning to request assistance from State agencies.

2) District 2

Since 1976 the district has added approximately 100 students and 5 or 6 teachers. The elementary schools have a little space; the Junior High is at capacity; and the High School could take 200 to 300 more students.

The district is selecting an architect for a new two- or three-section elementary. (A "two-section" would have two classes of each grade). The Junior High needs expansion, whether it remains as 7th and 8th grades or adds the 6th or 9th grade. The district is hopeful that both construction projects can be accomplished with available funds.

The bonding capacity currently available is about \$1.8 million. A State entitlement can be drawn for 7 years ahead, which would yield approximately \$1.5 million. This gives the district about \$3.5 million to try to meet the most urgent needs. In addition to capital expenditures, the operating expenses are needed for maintenance, busing, and administration offices. The district is currently engaged in extensive busing to equalize the load on schools.

6. Health Care

a. Health care facilities

The Sheridan County Hospital, completed in 1953, serves as the regional health care center for northeastern Wyoming and southeastern Montana. The facility is severely strained by a 43 percent increase in admissions from 1971 to 1976, and 128 percent increase in out-patient visits. Most functions of the hospital are cramped, or inadequate. The emergency room has experienced a 508 percent increase in use since 1965 and is in critical need of space. Surgery needs two or more operating rooms and a recovery area, and the laboratory and radiology sections need space.

A new 26-bed hospital is located in Hardin. It is well equipped for its size, with coronary care, surgery, and obstetrical units.

The Indian Health Service operates a hospital at Crow Agency for both reservations. An out-patient clinic is also located at Lame Deer.

Ambulance service in Sheridan County and the Decker-Southern Rosebud County area is provided by funeral homes in Sheridan with two ambulances and a backup unit. Big Horn County employees include three salaried, trained staff to operate two ambulances. The Indian Health Service provides ambulance service on the reservations.

b. Health care personnel

Since Sheridan serves as a regional medical center, it is well supplied with physicians for the county's needs. Big Horn County is considered to need 5 to 6 more doctors to meet the normal standard of 1 doctor per 1,222 of population.

c. Nursing and retirement homes

The Eventide Nursing Home operates in Sheridan. This facility has a capacity of 120 and an average staff size of 80. The Hardin Hospital has a 34-bed nursing-home wing. Another 22-bed home provides for those needing less attention.

Several housing developments for the elderly are planned or are under construction. Taken together, these facilities will probably meet the needs of the sizeable senior citizen population of Sheridan County. The existing facilities in Big Horn County have short waiting lists and are therefore considered to be adequate.

7. Law Enforcement

a. Sheridan

The Police Department and jail in Sheridan are located in the City Hall basement. The department would like to move the facility away from other city functions, possibly to a joint city-county facility. The jail is, at times, too small for the number of prisoners. No off-street parking exists for personnel or visitors.

The comprehensive plan recommended that a new structure be built, a juvenile officer and a woman officer be hired, and personnel and equipment be added as the population increases.

b. Ranchester

The town of Ranchester has a full-time and a part-time marshal. The marshal uses his home as an office and makes use of the county jail. Assistance is provided by the County Sheriff. The residents of Ranchester largely felt a need for more, better trained and equipped policemen. (Sheridan County Needs Survey, SAPA) An office for the marshal was the basic recommendation from the comprehensive plan.

c. Dayton

The town is provided part-time service by the County Sheriff's Office. Law enforcement was the greatest need identified by the Needs Survey. The comprehensive plan recommends that a full-time deputy sheriff be stationed in Dayton.

d. Sheridan County

The Sheriff's Department covers all unincorporated areas of the county. The office is housed in a 1913-vintage building containing offices, laboratory, interrogation rooms, and jail. The building is shifting due to poor soil conditions and therefore needs replacing. There is insufficient space for additional personnel.

The department is considered understaffed. At present, the department can only respond to complaints and provide assistance. No patrolling is possible. The National Standard of officers per 1,000 people is 2 and for Sheridan and Sheridan County, inclusive, is 0.79, lowest in the State. If the personnel can be obtained, there will be a need for equipment for them. In any case, training, administration, and equipment replacement must be funded. The immediate needs identified by the county comprehensive plan include remedying the above-mentioned problems and hiring three new officers and a dispatcher. Eventually, the department would like to provide full-time deputies in the towns and continue upgrading service.

e. Big Horn County

The offices of the County Sheriff and the Hardin Police recently merged. Except for the reservation police force, the Sheriff provides all police protection to the county. One deputy is half time constable in Lodge Grass. Another deputy and a truck are stationed in Lodge Grass. There is currently no resident officer in the Decker area. The area has had such an increase in problems and the serving of papers that it is considered imperative to station an officer there. Additional funding would be required to provide an officer for Decker.

8. Fire Protection

Sheridan County is served by 12 rural fire districts, a county crew at the airport, and city fire departments. The Sheridan Fire Department is considered adequate. Major improvements are underway in the water system to improve pressure and extend water to newly annexed areas. The major problem centers around the single station which is poorly located and reduces response time to outlying areas. The department would like to close the present station and construct two or three new ones. There is also a need for training areas. Sheridan has mutual aid agreements with the surrounding RFD's, the county airport, fire station, and the VA hospital. The city is purchasing a new aerial truck, and the county is getting a crash truck at the airport.

Dayton has a volunteer fire department with two men on call at all times. The district owns two trucks, a 300- and 600-gallon pumper. The water system is deficient, as noted earlier.

Ranchester has a 20-man volunteer department. Two trucks are owned by the district which includes the town. The water system deficiencies are noted on page II-70.

The Decker area of Big Horn County is covered by a volunteer fire department. The county has one 1,000-gallon pump truck stationed at Decker. Additional fire equipment is available at the mines but may not be available outside the immediate mine area.

K. LAND USE

1. Present Use

The 4,420 acres of land within the permit area is presently being utilized for livestock grazing, wildlife habitat, watershed, and, to a small extent, outdoor recreation. No farmsteads or residences are located within the permit area, nor is the permit area traversed by any public road or utility right-of-way.

The land surrounding the application area is also thinly populated and rural in character, the predominant use being livestock grazing. The Decker coal mine, in operation approximately 5 miles to the southeast, contrasts with this pastoral landscape. The small community of Decker, south of the Decker mine, provides some clustered residences and commercial services. Scattering of new residences (both temporary and permanent) has begun on the rural lands surrounding the Decker-Spring Creek area.

Tables II-29 and II-30 provide acreages by major use and ownership categories for Big Horn County, Montana, and Sheridan County, Wyoming. These figures show that the application area is similar to the broader region in grazing emphasis and in the small share of agricultural, urban, industrial, and wooded lands.

2. Land Use Planning

a. Federal planning

The administration of federally owned minerals, including mineral fuels, is the responsibility of the U.S. Bureau of Land Management (BLM). In the Spring Creek area, BLM administers a relatively small land-surface area but a much larger acreage of federally owned coal. Much of this Federal coal, therefore, is overlain by land in private ownership. The BLM is required to develop land-use plans, called Management Framework Plans (MFP's), for lands and resources under its care. Such an MFP has been developed for the Decker-Birney Planning Unit, within which the Spring Creek mine is proposed to be developed. The company's mining permit application, under analysis here, is compatible with the MFP recommendations for the Decker-Birney Planning Unit.

b. Local land use planning

1) Sheridan County

Land-use planning is relatively new to Wyoming. The State has mandated subdivision regulations at the county level. A law, requiring

TABLE II-29.--Land use in Big Horn and Sheridan Counties

[Source: Northern Great Plains Resources Program: Surface Resources Regional Profile Draft, February 1974]

	Acres	Percentage of county area
Big Horn County:		
Land area-----	3,214,020	99.35
Water area-----	21,180	0.65
Total county area-----	3,235,200	100.00
Irrigated cropland-----	48,400	1.50
Nonirrigated cropland-----	246,394	7.62
Total cropland-----	294,794	9.12
Pasture and rangeland-----	¹ 2,708,604	83.72
Forest and woodland-----	1335,874	10.38
Urban and built-up areas-----	211,979	0.37
Sheridan County:		
Land area-----	1,613,860	99.59
Water area-----	6,620	0.41
Total county area-----	1,620,480	100.00
Irrigated cropland-----	60,801	3.75
Nonirrigated cropland-----	57,690	3.56
Total cropland-----	118,491	7.31
Pasture and rangeland-----	¹ 1,191,328	73.52
Forest and woodland-----	1329,179	20.31
Urban and built-up areas-----	² 37,525	³ 2.32

¹The sum of the acreages by use exceeds the total county area due to double counting of pastured woodlands.

²Includes residential, commercial, industrial, and transportation uses -- does not include strip mines, gravel pits or borrow pits.

³Meadowlark, 1978, reported 20.29 percent for this category, including mining as an industrial use.

TABLE II-30.--Land ownership in Big Horn and
Sheridan Counties

[Sources: USDA, SCS - 1973 Conservation Needs
Inventory for Land Resource Planning Big Horn
County, Montana and Meadowlark, 1978.
Data are in percent]

Big Horn County	
Government-owned lands:	
Federal-----	1.0
State-----	2.6
Private- and Indian-owned lands-----	96.0
Urban-owned lands-----	0.4
Total-----	100.0
Sheridan County	
Government owned lands:	
Federal-----	28.3
State-----	7.9
Local-----	0.7
Subtotal-----	36.6
Privately owned lands-----	63.4
Total-----	100.0

local comprehensive plans, was very weakly worded, requiring only that a local government "may consider" certain topics and "shall consider" a very few. Recently, the legislature passed a bill which ultimately set up a housing board to provide low-interest mortgages for housing. The target group for these mortgages is lower middle and middle income people.

Sheridan County's response to the mandated planning was to form the Sheridan Area Planning Agency (SAPA), a council-of-governments organization that provided planning services to all towns and to the county. SAPA worked with the planning commissions for Ranchester, Dayton, Sheridan, and Sheridan County. SAPA produced a number of reports and studies culminating in comprehensive plans for each town and the county. The County Commissioners disbanded SAPA in 1977.

A small group was retained to "implement" the plans and obtain grant money. This has left no one but the planning commissioners to do the daily work on subdivisions, plats, parks, streets, and the numerous other projects coming before the board.

2) Big Horn County

Like Wyoming, Montana is new to land use planning. Local governments are permitted to plan and zone within their jurisdictions but are not required to do so. Big Horn County currently has a consulting firm retained to work with the planning commissions, as staff and to seek grants. The county produced a "comprehensive plan" in 1972, which was essentially documentation of the need for a plan rather than a plan itself. In October 1977, the County Planning Commission proposed a zoning package to try to manage the growth in the Decker area. A hearing has been held, but no schedule has been set for adoption.

At present two new towns are under consideration in the Decker area. One developer has selected a site near the Tongue River Reservoir and another is proposing a site along Route 314 north of the Decker mine. Plats have not yet been approved by Big Horn County, so the outcome of these developments is uncertain. A problem which faces any developer of a town or residential subdivision is locating a suitable site in the area which is not underlain by strippable coal.

L. TRANSPORTATION SYSTEM

1. Highways

The Spring Creek area is accessible from the north and south by Montana Federal-Aid Secondary Route 314 (Route FAS 314), which is a continuation of Wyoming Secondary Route 338 connecting to U.S. Route 87 and Interstate 90. Route FAS 314 is an all-weather road that starts at the Montana-Wyoming line and runs generally northward about 33 miles to its junction with U.S. 212, which is the only east-west highway across southeastern Montana. Because most roads follow stream valleys, travel between some points may be very indirect.

From the State line to a point about 5 miles north of the Decker area, Route FAS 314 has an asphalt surface; beyond that point the surface is coated with crushed clinker or gravel. The surface of the asphalt segment of the road is 28 feet wide, and the road has a design speed of 60 miles per hour. Traffic in the Decker-Spring Creek area has increased substantially in the last several years. Figure II-20 shows traffic levels above 600 vehicles per day on FAS 314. This highway is one of several proposed for reconstruction by the Highway Department. Although Route FAS 314 still functions as a primary farm-to-market facility, most of the current use represents daily round trips by mine employees living in the Sheridan area.

Relocation of 5.07 miles of FAS 314 is proposed by the Decker Coal Co. to make way for the North Extension of the Decker mine. The relocated section would be moved eastward along the shore of the Tongue River Reservoir and result in a lengthening of the route by 1.39 miles. The relocated section would have a length of 6.46 miles, from near the existing Decker coal loading loop to a point about 1 mile north of the mouth of

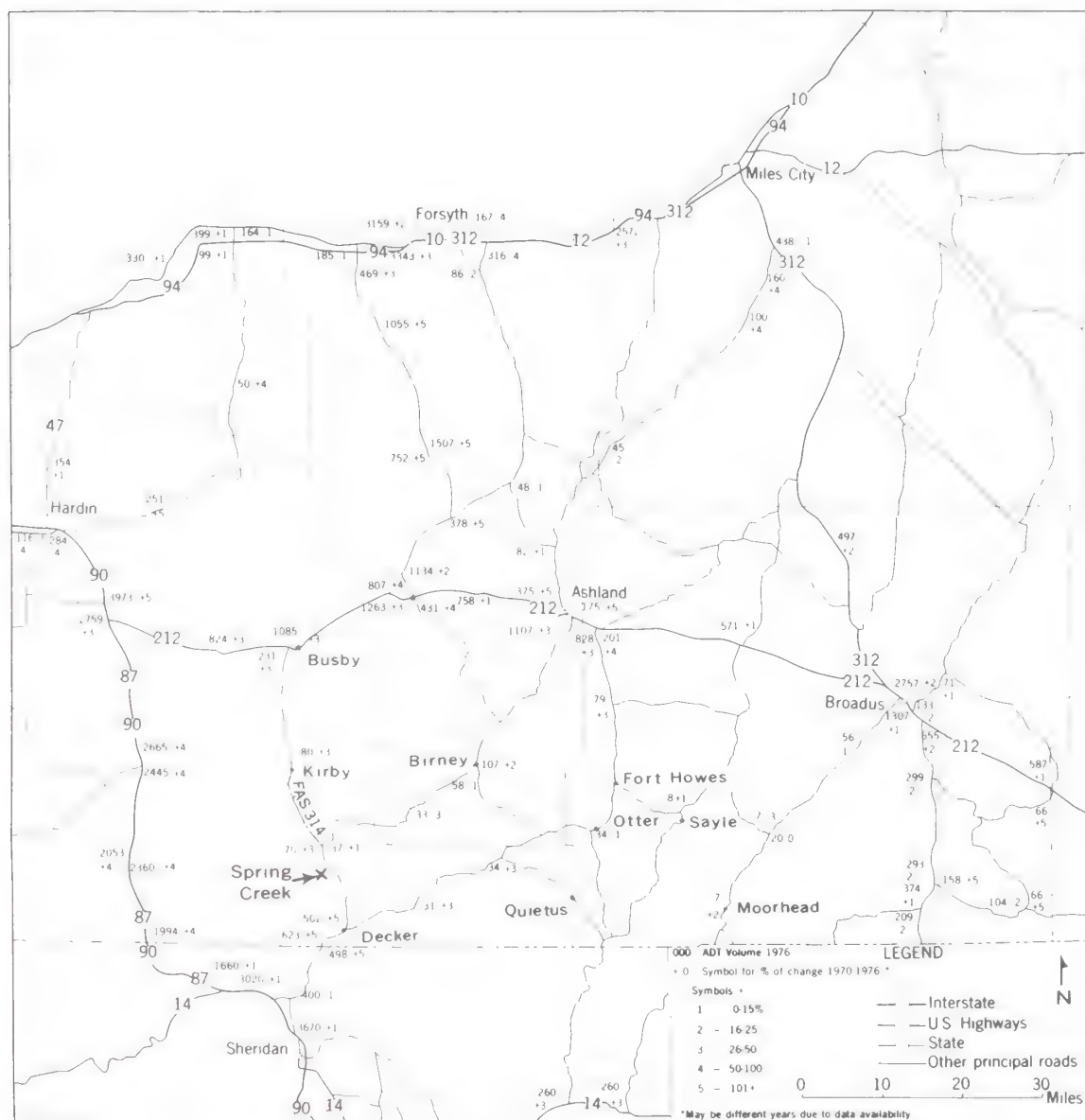


FIGURE II-20.--Average daily traffic on regional roads and highways.

Spring Creek. The rail spur to serve Spring Creek would lie to the west, or within the curve, of the proposed relocation route. Engineering designs of the rail spur and highway are being made separately, but both are constrained by the mine on the west and Tongue River Reservoir to the east. The Montana Highway Department is assisting Decker's consultants with the design, but the department has not announced a date of design completion.

2. Railroads

Figure II-21 shows the regional rail system serving the area in which the Spring Creek mine is located. A railroad spur approximately 19 miles long connects the West Decker mine with the Burlington Northern main line at Dutch Junction, about 5 miles east of Sheridan. This spur is used primarily to transport coal from the mine and, secondarily, to transport materials and equipment to the mine. Current traffic on this spur is approximately three unit-trains per day originating at the Decker mine. The proposed 9.6-mile extension to serve the Spring Creek mine would join the existing spur just south of the Decker mine loading loop.

The existing rail spur crosses FAS 314 at grade level south of the Decker mine. Public pressure has been focused on the problem of hazards and delays created by coal trains at this crossing and has resulted in plans by the Montana Highway Department to construct a grade separation. This project is planned for bid-letting in 1981 and should require about a year for construction.

Figure II-22 provides a schematic view of rail traffic on the system which will serve the proposed Spring Creek mine. From Dutch Junction, where Spring Creek trains would join or leave the main line, to the Sheridan area there are currently between 9 and 11 trains daily. An average of 10 trains per day move eastward from Dutch Junction through Gillette. At Donkey Creek Junction, additional coal traffic increases the load to 22 trains per day.

Line capacity in 1977 for the main line between Huntley, Montana, and Alliance, Nebraska, has been estimated by the Interstate Commerce Commission at 25 trains per day. The segment east from Donkey Creek is operating near capacity now. The Burlington Northern is engaged in a 5-year program of facility improvement which involves this track segment. Burlington Northern anticipates that, by 1980, capacity will be raised to 60 trains per day. At the same time, the rail link under construction between Donkey Creek and Douglas, Wyoming, will have been completed providing an alternate route with a capacity of approximately 40 trains per day.

Table II-31 provides a comparison of 1977 rail traffic with expected increases for the various segments by 1981.

3. Other Transportation

Airline service is provided at Sheridan by Western Airlines. Major connections can be made at Billings, Casper, and Denver. Two private companies provide charter and air-ambulance services from Sheridan.

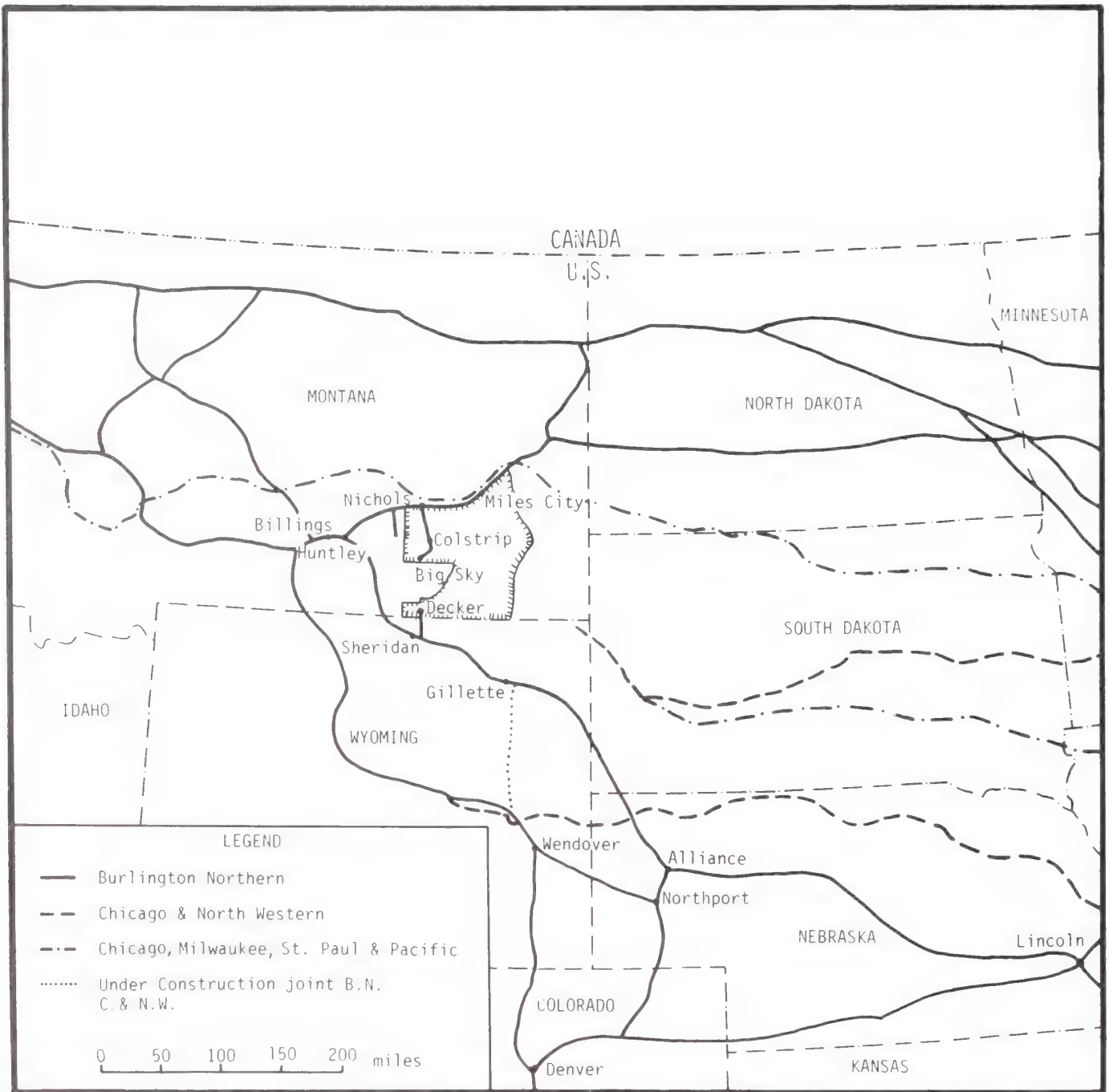


FIGURE II-21.--Major railroads serving the Powder River region.

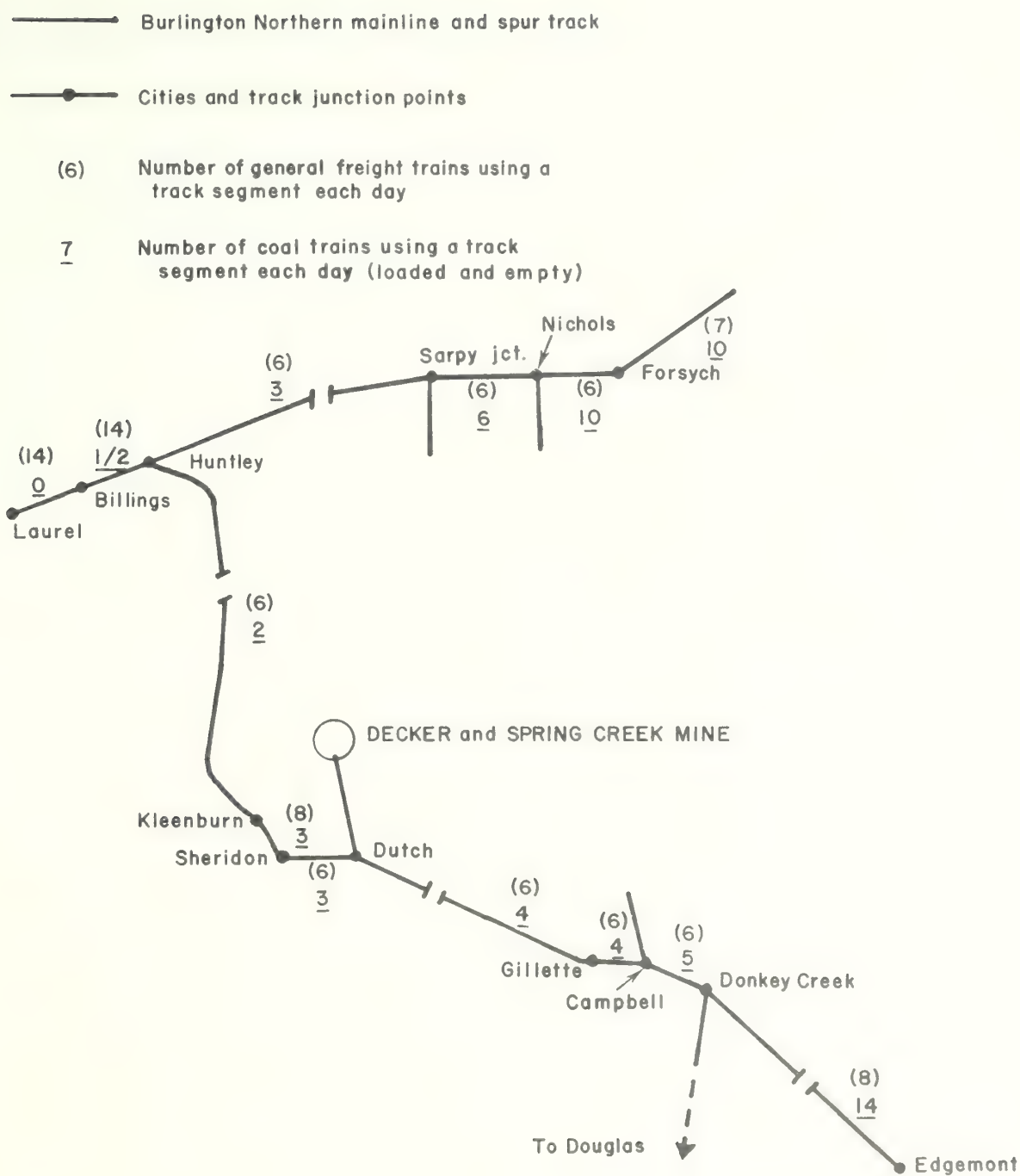


FIGURE II-22.--Traffic of the rail system serving the proposed Spring Creek mine, 1977.

TABLE II-31.--Rail traffic projections for selected Burlington Northern line segments

[Source: Office of Vice President, operations B.N., Inc., St. Paul, Minn., November 7, 1977]

Line segment	Trains per day 1977 ¹		Trains per day 1981 ¹	
	Coal ²	General freight	Coal ²	General freight
Edgemont, S. Dak., to Donkey Creek-----	14	8	33	9
Donkey Creek to Campbell--	5	6	19	7
Campbell to Gillette-----	4	6	9	7
 Gillette to Dutch-----	4	6	9	7
Dutch to Sheridan-----	3	6	8	7
Sheridan to Kleenburn-----	3	8	8	9
 Kleenburn to Huntley, Mont.-----	2	6	8	7
Huntley to Sarpy Jct.-----	3	6	7	7
Sarpy Jct. to Nichols-----	6	6	11	7
 Nichols to Forsyth-----	10	6	17	7
Huntley to Billings-----	1/2	14	1	16
Billings to Laurel-----	0	14	1	16

¹Does not include switching movements.

²Loaded and empty.

The Wyoming Public Service Commission has authorized Wyoming Airline, Inc., to begin commuter air service between Sheridan, Casper, Gillette, and Cheyenne effective May 1, 1978.

Bus service is available at Sheridan through one company. A taxi service also operates.

The Spring Creek area has no public transportation, nor does Spring Creek or Decker Coal Companies plan any mass transportation for their workers. The minesite is now reached by a private dirt road up Spring Creek from FAS 314. An access road is planned, entering the permit area from the north (figs. I-9 and I-10).

M. RECREATION

Due to the rural nature of the Spring Creek area, recreational facilities and use are oriented toward outdoor-type activities. There are no developed recreation facilities in the proposed mine area and

because most of the land is privately owned, the opportunities for general public use are limited.

1. Outdoor Recreation

Recreational use is concentrated at the Tongue River Reservoir, 4 miles east of the permit area, which provides opportunities for camping, picnicking, boating, fishing, water skiing and water-fowl hunting. Existing recreational facilities are generally in poor condition but include latrines and shelters, two natural boat ramps, a vista area, and two semideveloped camping sites (fig. II-23). Grills and garbage cans are located intermittently along the reservoir.

Considerable recreation potential for fishing, hunting, and floating exists along the Tongue River, both upstream and downstream from the reservoir. Recreational use of the river, however, is limited by lack of designated access points (Montana Department of Fish and Game, 1976).

Hunting for big game and upland game birds is the major land-based recreational activity in the area. Several other activities, such as off-road vehicle use (ORV), hiking and cross-country skiing, are also included in this area to a lesser degree.

The Custer and Bighorn National Forests are the major public lands available in the area, providing a variety of outdoor recreation opportunities. Although public use in the Custer National Forest has declined over the past 5 years, use of the Big Horn National Forest has steadily increased; however, the majority of that use is believed to come from the Billings and Casper areas (USFS, 1977).

2. Urban Recreation

Recreational facilities are offered at Sheridan, Wyoming 28 miles south of the mine area. These include a swimming pool, tennis courts, golf course, gymnasium, ice-skating rinks, parks, playgrounds, ball fields, zoo, Y.M.C.A., and civic center. Most community parks and ballfields are only partially developed, many offer no facilities and all are poorly maintained (Meadowlark Group, January 1978). Only one developed playground now exists.

Due to the influx in population, the demand for recreational services and facilities is increasing. Recreational preferences within the community are changing as the average age of the population becomes lower. The need for improved recreational facilities exists at the present time, and future needs are inadequately defined.

Numerous historic sites and tourist attractions are located in Sheridan and the surrounding areas.

Actual use figures for most recreation facilities are not available. Generally both outdoor and urban facilities appear to be well used at present, with little or no room for expanded use.

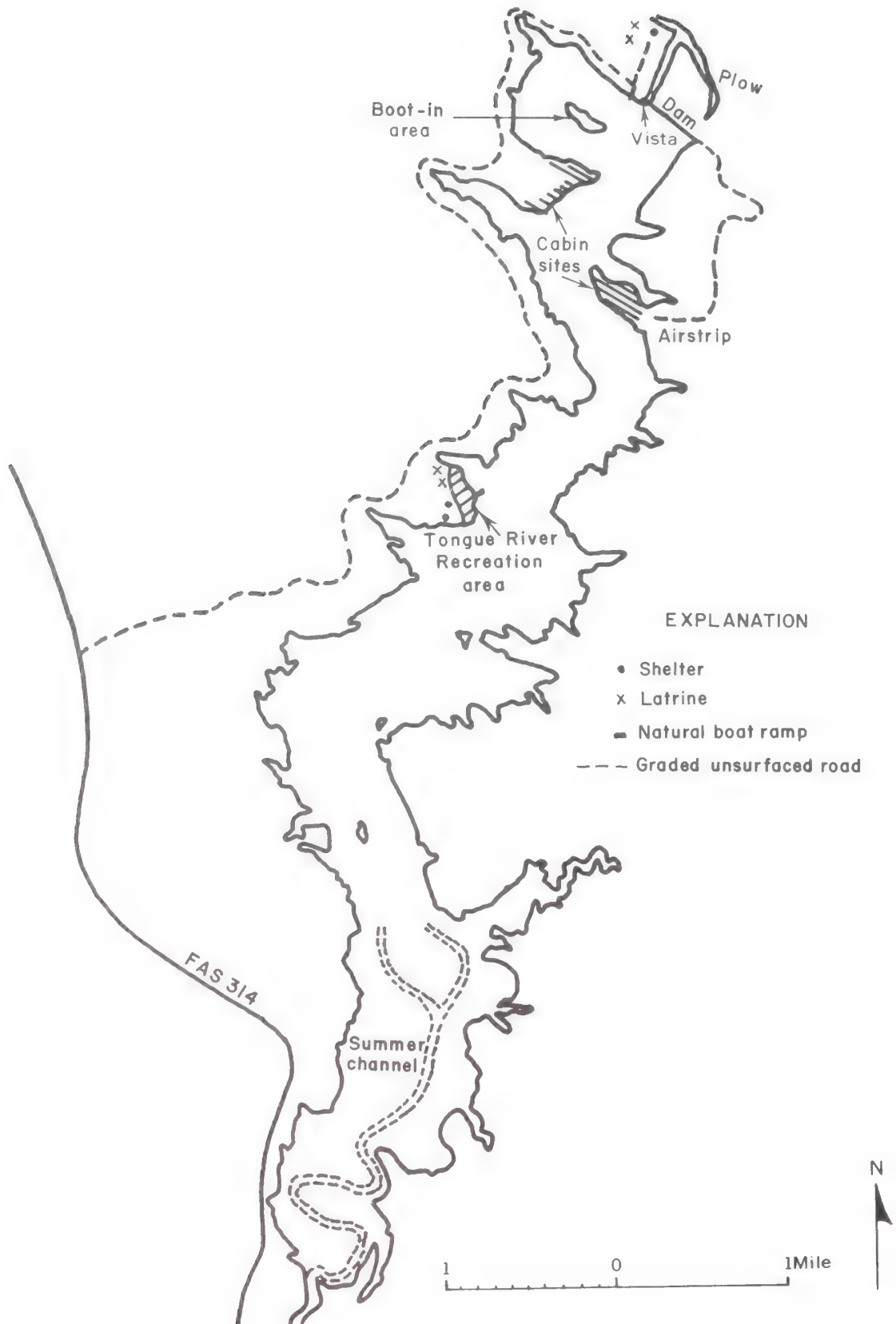


FIGURE II-23.--Map of Tongue River Reservoir showing existing recreational facilities.

N. CULTURAL RESOURCES

1. Archeology

Cultural resources are fragile and non-renewable remains of human activity, occupation, and endeavor.

Until the recent interest in mineral development, few cultural resource investigations had been conducted in southeastern Montana. The area of the proposed Spring Creek mine was surveyed by Haberman (1973), Taylor (1977), and Anthro Research, Inc. (1977) (fig. II-24). A general summary of the identified cultural resource sites and their types is presented in table II-32.

TABLE II-32.--Summary of identified cultural resource sites in the area of the proposed Spring Creek mine

Site type	Haberman (1973)	Taylor (1977)	Anthro Research, Inc. (1977)
Prehistoric:			
Lithic scatter-----	1	6	39
Chipping station-----	1	9	5
Quarry site-----	1	2	0
Rock shelter-----	0	1	0
Occupation site-----	2	13	4
Petroglyph site-----	1	0	4
Medicine wheel-----	0	1	0
Tipi ring-----	0	0	1
Historic:			
Homestead-----	0	3	0
Total-----	6	35	53

No sites currently listed on the National Register of Historic Places or the Montana Historic Sites Compendium are in the area of the proposed mine. Sixteen sites in the area of the proposed mine have been determined to be eligible for inclusion on the National Register of Historic Places, a summary of these is presented in table II-33.

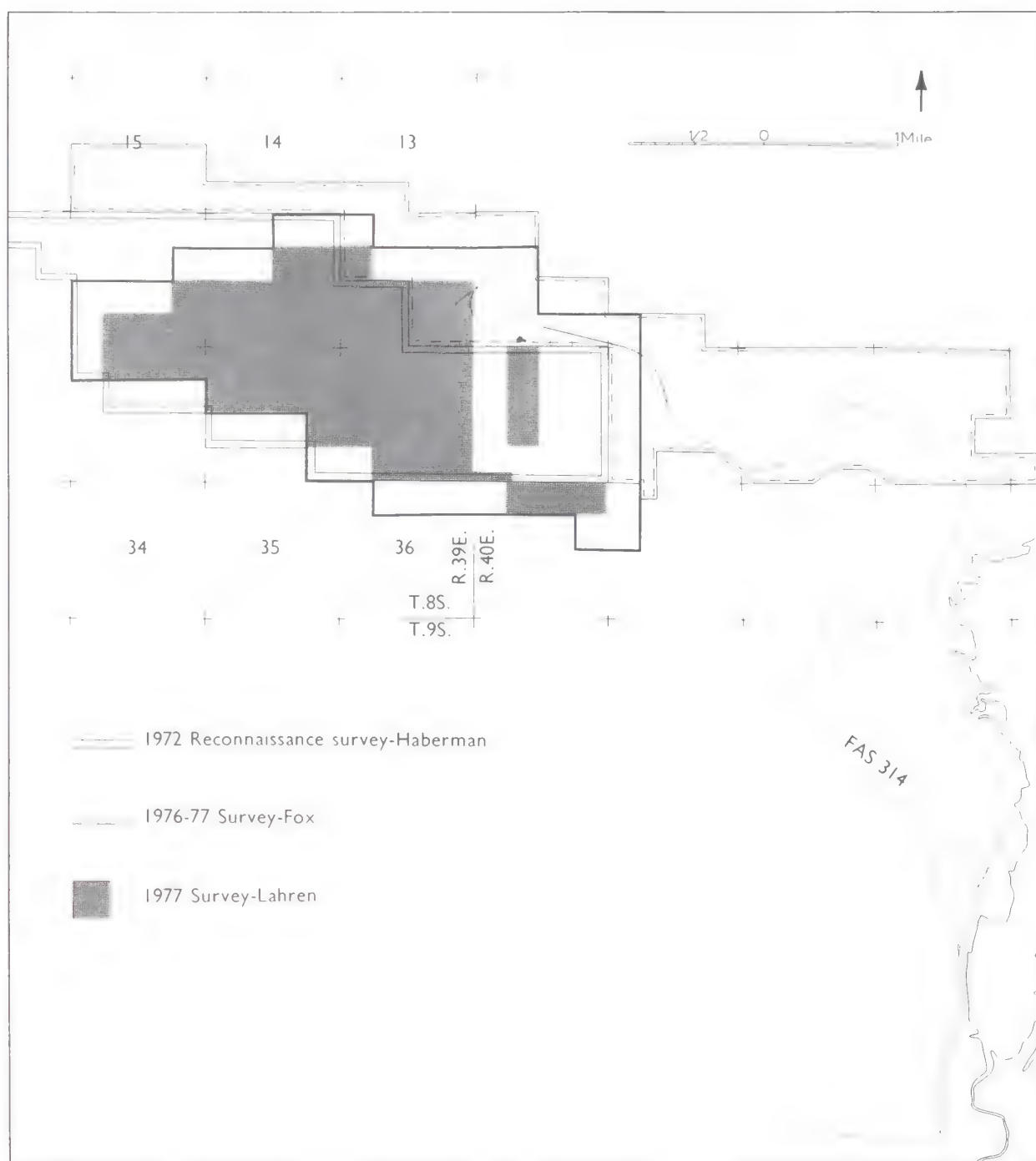


FIGURE II-24.--Map showing cultural resource surveys of the Spring Creek area.

TABLE II-33.--Summary of cultural resource
sites determined to be eligible for the
National Register of Historic Places

Montana site number	Site type
24 BH 1045-----	Lithic scatter
24 BH 1046-----	Petroglyph site
24 BH 1052-----	Chipping station
24 BH 1583-----	Lithic scatter
24 BH 1589-----	Quarry site
24 BH 1591-----	Occupation site
24 BH 1593-----	Occupation site
24 BH 1595-----	Occupation site
24 BH 1597-----	Quarry site
24 BH 1602-----	Occupation site
24 BH 1606-----	Lithic scatter
24 BH 1609-----	Quarry site
24 BH 1610-----	Occupation site
24 BH 1614-----	Occupation site
24 BH 1618-----	Occupation site
24 BH 1619-----	Chipping station

2. Historical Overview

a. Big Horn and Sheridan Counties

Sheridan County and the city of Sheridan have had a tradition of coal mining. This mining occurred from the 1890's to 1953 and was basically deep shaft mining. The last deep mine was the mine at Monarch, Wyoming. Most of this coal was utilized for rail use and home consumption. Sheridan County experienced a major economic boom attributable to coal production and homesteading between 1890 and 1910.

The area has been predominantly agriculturally based with ranching and grazing operations. During the 1940's, 1950's, and 1960's, economic stagnation occurred in the area. In the 1970's, strip mining, oil exploration activity, and general economic growth have brought increasing material growth to the area. A large mine just over the Montana line at Decker was opened in 1972 which contributed to this boom. The city of Sheridan has been the regional marketing center for the area, and the city of Sheridan has grown from the most current activities related to fossil fuel.

Big Horn County, Montana, has also been an agriculturally based economy since its inception as a county in 1913. No booms occurred in this county, and prior to 1970 and with the exception of the county seat of Hardin, the area has remained essentially rural. With the advent of new mining in Big Horn County, most of the impacts have been felt in Sheridan County and the city of Sheridan from the spillover effects from the Montana mines.

1) Crow Indians

The Crow Indians (Absaroka) were the first of the Plains Indians to move into the general vicinity of the Missouri and Yellowstone Basin. This occurred in the 17th century and was made up of about four hundred people. The Crow Indians were historically an agriculturally based tribe; however, when they settled in the Missouri and Yellowstone River Basin, they became nomadic hunters, relying upon the buffalo for their livelihood. By the mid-1700's, the Crow Tribe had established itself as the rightful owner of an area bounded by the Powder River on the east, the Wind River Mountains on the south, the Rocky Mountains on the west, and the Missouri River to the north.

The first treaty signed with the U.S. Government was in 1825, and in 1851 the Crows signed the Treaty of Fort Laramie, which entitled them to 38,883,174 acres in Montana and Wyoming as a hunting reservation. In 1868 the Federal Government reduced the original reservation area to 9 million acres, of which the majority lies in what is now known as Big Horn County, Montana.

In 1884, the Crow Agency was established to help the Crows create an economy based on agriculture. During the 1880's and 1890's, the Crows sold much of the better agricultural land to non-Indians to pay for their own water irrigation projects. Reservation land area was further reduced to 1,569,288 acres since the early treaties. In 1904 the "ceded area" was formed by the sale to non-Indian settlers of approximately 1.1 million acres of land that had been previously part of the reservation, north of the present reservation boundary. In 1958, all vacant and undisposed ceded land was restored by Congress to the Crow Tribe, along with the mineral rights to the coal resource in an area of about 150,000 acres.

Today the Crow Tribe consists of approximately 5,500 tribal members living on or near the reservation. Most of those members who are living on the reservation are concentrated along Interstate 90 and the Little Big Horn Valley.

Within the boundaries of the Crow Reservation are substantial sub-bituminous coal deposits. Only Shell Oil holds a coal lease on the Crow Reservation proper. Gulf Mineral Resources and Peabody Coal Company hold prospecting permits with an option to lease. The only production in the "ceded area" is from Westmoreland, who is currently producing coal from within Tract III, a lease encompassing approximately 14,745 acres.

2) Northern Cheyenne Indians

The Northern Cheyenne Indians came to the plains area in the 17th century as a result of pressures from American and Canadian westward expansion. They were nomadic Indians using horses, and hunted for their livelihood. Prior to then, they had been basically agricultural people. After the Civil War, the Cheyenne peoples came into direct conflict with the White man over hunting territories. This dispute culminated in 1876 with the Battle of the Little Big Horn.

The Northern Cheyenne Indians participated in the Friendship Treaty (1825), the Ft. Laramie Treaty (1851), and the Treaty of 1868, which granted a large hunting domain for them. In 1884, the Tongue River Reservation was established. It consisted of 371,200 acres in southeastern Montana. Later the name was changed to the Northern Cheyenne Indian Reservation.

In 1934, under the Wheeler-Howard Act, the Northern Cheyenne Indians were granted authority to establish a democratic tribal council with a president and five voting districts.

As of 1974, there were 444,308 acres of land within the reservation. More than half of the land was purchased by the Northern Cheyenne tribe.

The Northern Cheyenne Reservation is underlain by an estimated 5.2 billion tons of coal. Since the mid-1960's, much controversy has existed over the control of this coal. The ownership and/or control controversy was between the tribe and the allottees. A 1976 Supreme Court decision settled this disagreement in favor of the tribe.

0. ESTHETICS

The proposed mine area can be described as a quiet and peaceful tract of grazing land with average scenic values (Class C-8 based on the Visual Resource Management System of the Bureau of Land Management, appendix 0). Evidence of manipulation by man is limited. The area varies topographically from stream valleys to gently rolling hills, rocky canyon walls, and sandstone buttes. There is a moderate variety of color, including scattered patches of dark green pine trees, red clinker, and tan sandstone. Vegetation produces variations in patterns and textures. The predominant odors in the area are those of the vegetation. Noises in the area are those from distant mining equipment at the Decker mine, vehicles and farm equipment, livestock, wildlife, and wind.

CHAPTER III

PROBABLE IMPACT OF THE PROPOSED ACTION

A. GEOLOGY

The most important geological impact from implementation of the mine plan would be increased erosion and deposition in the permit area. Because the mine plan does not include adequate mitigating measures, the reclaimed land surface would be subject to long-term instability, thereby limiting reclamation and future land use. (See chapter III, Land Use.) Destruction of the stratigraphic sequence would also affect ground water, soils, and vegetation.

The 243 million tons of coal removed would be irretrievably committed to the beneficial use of the resource but would be lost from future use. This would not interfere with future development of other mineral resources in the area.

1. Topography and Geomorphology

The primary adverse impact on topography and geomorphology from mining would be a decrease in stability of the disturbed land surface. This instability would increase the geologic processes of erosion in some places and deposition in others, primarily within the permit area; hence, reclamation and revegetation would be hindered. The instability of the land surface would locally impact soils and vegetation and, to some degree, would limit future land use. (See appropriate sections.)

During mining, erosion would be accelerated by an unknown amount as a result of both the surface disruption by men and mining machinery and by the construction of the proposed diversion channels. Also, an unknown amount of hillslope sediment movement would occur as the slopes reestablish an equilibrium with the steeper diversion-channel gradient.

The ridge between the two forks of Spring Creek would be eliminated because there would be insufficient spoil material to return the land surface to the approximate original contour and at the same time maintain stream gradients (fig. I-20). The ridge would be replaced by a broad, gentle, southeasterly-sloping plane about 3 miles long.

Reclamation would follow mining in incremental stages, thereby minimizing potential wind erosion. Local irregularities may be expected to occur on the reclaimed surface because of variations in initial grading and differential spoil subsidence. To the extent that depressions may form, surface water and sediment would collect in these depressions and therefore would not reach the major stream channels.

Either of two adverse impacts could result from water collecting in local depressions, depending on whether the water infiltrates or the depressions seal and the water evaporates. (See also Lusby and Toy, 1976.) Infiltration would increase spoil subsidence, whereas evaporation would

tend to concentrate salts on the surface. The presence of excessive salts would be adverse to plant growth.

Severe rill and gully erosion would occur on highwalls regraded to the proposed 3:1 slopes (about 20°). These slopes would be as much as 200 feet high and as much as 600 feet long; erosion control in the semiarid West has not been proved on slopes of such length and gradient. The particulate nature of topsoil used in reclamation would likewise not be conducive to stability on long, straight, steep slopes.

The regraded highwalls would intercept the drainages of the ephemeral tributaries to Spring Creek and South Fork, thus initiating headward erosion at these points. This would result in severe erosion above the highwall slopes and deposition of sediments on the sloping plane below them. Erosive processes likely to be active above the highwall would be rill and gully formation, as well as deepening of the tributary channels. Approximately 700 acres south of South Fork would be affected.

Mining would create a topographic surface in disequilibrium with the surrounding landscape. The long-term result of this disequilibrium would be accelerated erosion throughout both the mine area and the Spring Creek drainage. Studies of activities similar to mining indicate that sediment yield to the mine area would increase about fivefold over present rates (Gregory and Walling, 1973). Postmining erosion may decrease in time as equilibrium is regained and as revegetation takes place; however, this cannot be predicted with reliable accuracy.

2. Overburden

Mining would destroy the natural overburden stratigraphy which would have impacts on soils, vegetation, and ground water (these impacts are discussed in their respective sections).

3. Paleontology

Impacts to paleontological resources would consist of losses of plant, invertebrate, and vertebrate fossil materials for scientific research, public education (interpretative programs), and to other values. Losses would result from destruction, disturbance or removal of fossil materials as a result of coal mining activities, unauthorized collection, and vandalism.

A beneficial impact of development would be the exposure of fossil materials for scientific examination and collection which otherwise may never occur except as a result of overburden clearance, exposure of rock strata, and mineral excavation.

All exposed fossiliferous formations within the region could also be affected by increased unauthorized fossil collecting and vandalism as a

result of increased regional population. The extent of this impact cannot be presently assessed due to a general lack of specific data on such activities.

B. HYDROLOGY

The loss of the surface water (one perennial spring on the South Fork and several ephemeral impoundments on the permit area) would limit future use by livestock and wildlife. The company's proposed mitigating measures are not adequate in that the five water impoundments would fill with sediments in about 10 years, thus making them useless without further maintenance. Proposed stream diversions may be subject to erosion. The company does not propose to construct sediment retention facilities on these diversions and therefore, to the extent sediment may be eroded, some sediment may leave the permit area. Although the company proposes to comply with State and Federal regulations, off-site sedimentation would be in violation of these regulations. Postmining runoff from the permit area would be reduced by a small amount, as would sediment yield; at the same time erosion would increase an unknown amount within the permit area, mainly on the valley walls and at steepened points of the regraded highwalls. (See chapter III, Geomorphology.)

The loss of the ground-water supply (the alluvial and Anderson-Dietz aquifers, the sources for the spring and several wells) would have an adverse impact on the future use by livestock and wildlife. The destruction of the alluvial aquifer would be particularly important because it is the source of the only perennial surface water on the permit area; its loss would additionally preclude successful reestablishment of present vegetation. (See Vegetation.) However, the impact to livestock would decrease in significance because, although the proposed plan does not contain the appropriate measures, the impact can be mitigated by obtaining water from deeper aquifers. The impact to wildlife and vegetation, which are dependent on water from the alluvial aquifer, on the other hand, would be significant because it cannot be mitigated. The quality of ground water in the Anderson-Dietz aquifer east of the permit area may be degraded because of the leaching of spoils and may thereby become unacceptable for usage.

1. Surface Water

Mining would destroy the spring issuing from the alluvium along South Fork Spring Creek, which is the only perennial surface water resource on the permit area; destruction of the spring would preclude livestock and wildlife use of it, hence diminishing the value of the area for postmining use. Seven stock ponds would be destroyed and then replaced with five new impoundments having a combined total capacity of about 100 acre-feet, far surpassing the capacity of the existing ponds. The proposed impoundments in the permanently relocated channels would function as traps for sediment derived upstream from the permit area during flow events

and would fill with sediment rather quickly, thereby losing their effectiveness. The rate of infilling would vary greatly with the intensity of runoff events. And, if head-cutting should occur, the life of the structures would be reduced to, perhaps, a few years.

Given the premining sediment yield from the South Fork drainage of about 6.5 acre-feet annually, the three ponds on South Fork would, beginning with the upstream pond, theoretically fill up in about 10 years. It is assumed that the two ponds on Spring Creek would fill at a similar rate.

The temporary diversion channels are not designed for flood flows of a 50-year frequency and may become sources of sediment that discharge from the permit area. The probability of a 50-year event or larger occurring at least once during the life of the mine is 40 percent. During the life of the mine, the two stream diversions would normally carry a little less water than before mining because of the loss of contribution from the mine area, but the decrease would be negligible.

During mining, sediment generated along the diverted reaches of Spring Creek and South Fork may increase slightly for runoff events of less magnitude than a 10-year frequency. The diversions would be constructed on hillsides to allow mining of the stream bottoms; thus, an increase in sediment yield would be expected. Under the proposed gradients and channel design, sediment yield may increase gradually to significant amounts for 10-year frequency and greater floods. A 50-year peak flow would probably erode the 1-foot clinker lining proposed for the diversion channels. Velocities would be especially high in the lower reaches of the diversion channels where the gradients steepen. Head cuts could form at the points where the slopes increase. Because no sediment retention facilities are planned on the diversion channels, sediment eroded from these channels would leave the permit area.

Erosion could widen the channels. If the channel were to be widened 2 feet, Spring Creek, with 10,800 feet of diversion channel, would yield about 8 acre-feet of sediment, and South Fork, with 22,600 feet of channel, would yield about 17 acre-feet of sediment. Greater scouring would, of course, cause progressively more sediment yield from the banks, and perhaps, a significant amount from the channel bed. Should there be increased evaporation and infiltration from the postmining surface, the annual runoff from the permit area would be decreased. If all the runoff from the mine area were to be lost, the loss to the Spring Creek system would be less than 10 percent; therefore, this impact would not be significant.

After mining and reclamation, the amount of sediment leaving the permit area would remain the same as during mining, and may decrease somewhat compared to premining or natural conditions. Because the reclamation would leave a flat area with a 1-percent slope toward the east, the sediment yield from the area should be less. The accumulation of sediment from erosion of the reclaimed highwalls would not reach the reconstructed stream channels.

Quality of surface runoff from the reclaimed area would be little changed from premining conditions, except during periods of abnormally high peak flows, when the quality of the water would likely be degraded by an unknown but insignificant amount.

Neither the railroad spur nor the access road to the mine would likely yield significant amounts of sediment; both would be metaled with clinker, which is highly permeable and coarse enough to resist significant erosion. Moreover, sediment from the access road would be trapped in borrow pits at the base of side slopes. Depending upon the intensity of runoff events, minor amounts of sediment may reach the Tongue River Reservoir from railroad crossings on Pearson and Spring Creeks. However, sediment from this source should have an insignificant impact on surface water quality.

Leaching of Spring Creek mine spoils is not expected to add significant amounts of dissolved solids (less than 0.1 percent) to the Tongue River. Contributions of dissolved solids from other concurrent mining in the region are estimated to add about 0.3 percent to the dissolved solid load of the Tongue River.

2. Ground Water

The physical removal of the alluvium of South Fork and the Anderson-Dietz from beneath the permit area would have little impact on ground water because mitigating measures are feasible. Destruction of the alluvium would create the greatest impact because it is a source of spring water used by livestock and wildlife. The destruction of the alluvial aquifer along South Fork Spring Creek would also preclude reestablishment of vegetation similar to that now growing along this stream. (See chapter III, Vegetation.)

No significant impacts to the alluvial aquifer west of the permit area are foreseen, although the one perennial pond on South Fork immediately west of the area might drain because of disruption related to mining activities.

A source of well water within the mine area would be lost through removal of the Anderson-Dietz aquifer. In turn, removal of the aquifer would adversely affect two existing wells adjacent to the permit area. The water level in a well in the NE1/4NE1/4 sec. 31 would probably drop to near the bottom of the well, and the unused well in the west-central part of sec. 24 would probably become dry. The well in the NW1/4NW1/4 corner of sec. 24 is deeper than the well identified above and should not be seriously affected.

The quality of ground water likely would be degraded in the Anderson-Dietz aquifer east of the permit area because magnesium sulfate leached from the spoils would migrate into the undisturbed, downdip coal and clinker horizons adjacent to the mined aquifer. The water moving to the east would be diluted by local recharge; hence, the suitability of that

mixed water for use by livestock is uncertain. Water samples from wells drilled in the spoils at the nearby Decker mine contain about 4,300 milligrams per liter of dissolved solids; this water may not be suitable for either domestic or livestock use.

At present no wells in the area east of the mine would be likely to survive the lowering of the water table resulting from the Spring Creek and the Decker North extension mines; therefore, decreased water quality would not be significant to local water use.

Leaching of Spring Creek mine spoils is not expected to add a significant amount of dissolved solids (less than 0.1 percent) to the Tongue River. Contributions of dissolved solids from other concurrent mining in the region are estimated to add about 0.3 percent to the dissolved solid load of the Tongue River.

C. CLIMATE

The impacts of the proposed mine on the microclimate are estimated to be localized and quantitatively unknown. However, assuming reclamation is successful, we anticipate slight changes in humidity, temperature, and wind patterns resulting from changes in topography and vegetation.

D. AIR QUALITY

The extraction of 243 million tons of coal from the Spring Creek mine would degrade the air quality of the area. This primary or direct impact to the airshed would then effect changes in biological systems, termed secondary impacts.

Since the dust mitigation outlined for the Spring Creek mine is unclear and insufficient, air quality impacts are inferred from potential (uncontrolled) particulate emissions. These emissions could be substantially reduced with control technologies listed in chapter VIII, Alternative Mitigations.

Primarily, the airshed would be subjected to large quantities of particulates (fugitive dust) and, to a lesser extent, emissions of the pollutant gases--sulfur dioxide, nitrous oxides, and carbon monoxide. These emissions would continue for a minimum of 25 years, the period of active mining. Prevailing surface winds in the Spring Creek area would tend to add dust from the Spring Creek mine to dust from the Decker mines.

Secondary impacts include: (1) deposition of particulates in areas of high vegetative productivity, (2) minor changes in plant community productivity and composition, (3) potential trace element toxicity to insects, (4) detectable increases in respiratory disease in domestic animals, and (5) possible respiratory disease in mine personnel.

The mining processes associated with these increased pollutant emissions are:

1. Topsoil: removal, transport, and storage;
2. Overburden: blasting, removal, deposition, and storage;
3. Coal: blasting, extraction, and transport to storage area;
4. Coal processing;
5. Transport of the coal via unit train to utilization site;
6. Reclamation: replacement of overburden, topsoil, and revegetation;
7. Vehicular traffic in and around the mine area;
8. Increased population.

The major pollutant would be particulates (fugitive dust) composed of topsoil, overburden, and coal dust. The potential annual fugitive dust emissions would be 21,200 tons per year. This is assuming no emission controls. For comparison, the total annual particulate emissions from Colstrip units 1 and 2, at full generation capacity, is predicted to be 1,613 tons per year (Montana DHES, 1974).

1. Primary Impacts

Beginning in the third year of operation, 10 million tons of coal would be extracted annually from the Spring Creek mine. The Decker mine, about 5 miles southeast, is presently producing an equivalent tonnage.

Based upon observations at Decker, the annual baseline concentration of total suspended particulates (TSP) at Spring Creek would increase by a factor of 3.5 near major traffic routes and coal handling facilities. This would violate Federal secondary standards and approach violation of Federal primary and Montana State guidelines.

The maximum allowable Montana guidelines and Federal primary standards for 24 hour TSP concentration would also be exceeded several times annually. Figure III-1 illustrates the range and magnitude of 24-hour TSP concentrations due to the Decker strip mine, whose dust mitigation techniques are similar to (although not as extensive as) those listed under "Alternative Mitigation Measures," chapter VIII.

With a potential increase of particulate emissions of 21,000 tons annually, there would be a substantial increase in dustfall in the area with possible violations of Montana State guidelines. This trend is evident at Colstrip, Montana. Dustfall has increased fourfold above a baseline of approximately 10 tons/mi²/month.

Since the dominant winds are from the northwest (see Climate, chapter II) particulates from the Spring Creek mine can also be expected to contribute to a decrease in visibility and esthetics in the Tongue River Reservoir-Decker area. The Northern Cheyenne Indian Reservation would not be affected.

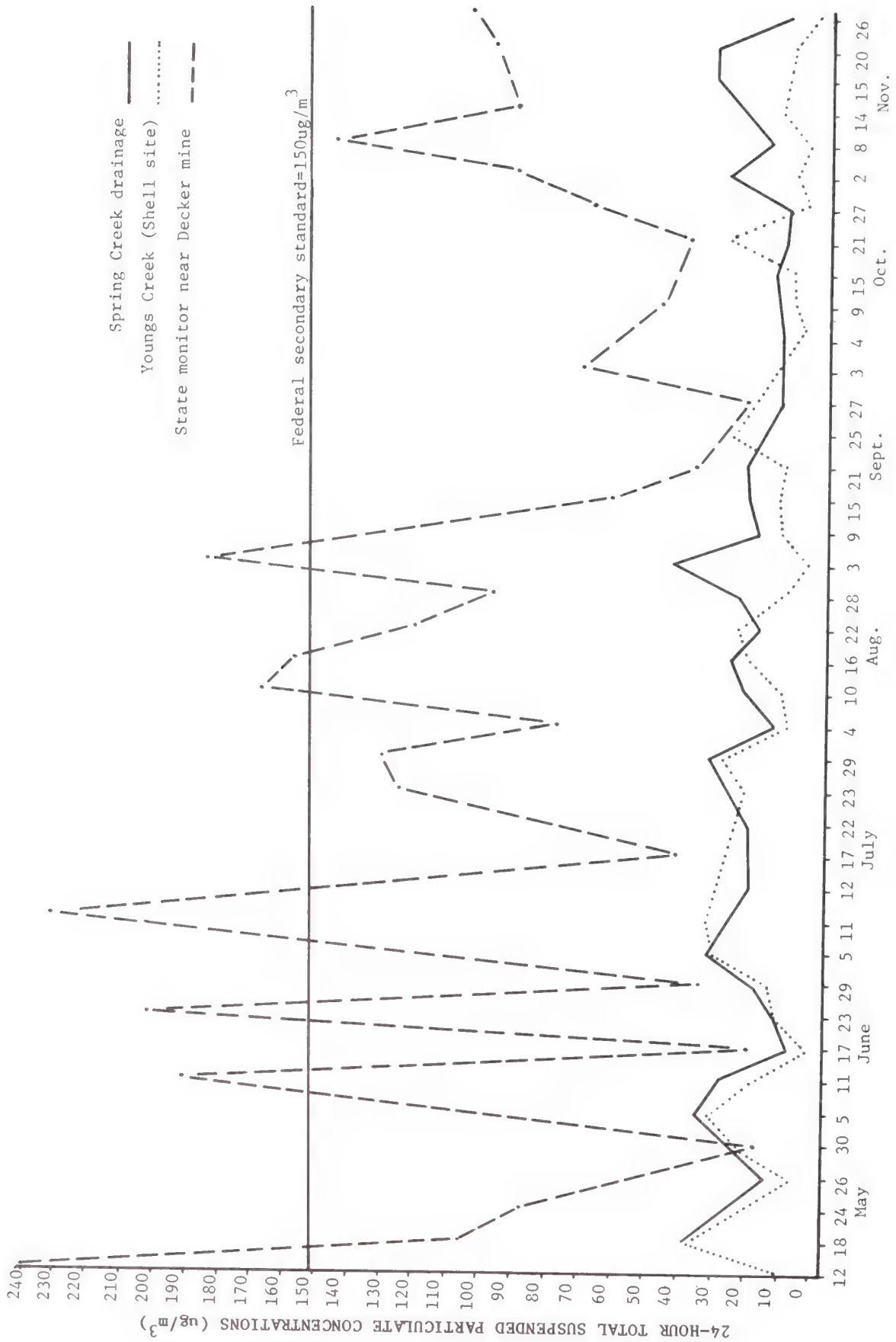


FIGURE III-1.--Comparison of records of the Decker high-volume air sampling station to Spring Creek and Youngs Creek records for the same period, 1976.

The emission of gaseous pollutants from the mining operation would have a lesser impact on air quality. Generally, there would be no violations of the air quality standards. However, NO_x fumes from blasting episodes and coal bank fires emissions could cause temporary danger to public health and safety, and to the immediate environment. The frequency of coal bank fires is difficult to predict. Gaseous emissions, extrapolated from abandoned, underground mine fires (Dunrod and Osterwald, 1978), include carbon disulfide, carbon oxysulfide, methane, helium, carbon dioxide, and an unknown sulfur compound. Carbon monoxide may range from a trace to 3,500 ppm at the source, according to one analysis conducted by MESA, cited in Dunrod and Osterwald, 1978. Temperatures may reach 925°C, much more than that needed to volatilize other noxious elements such as flourine. Since these emissions are usually accompanied by steam, acid misting by the transformation of sulfurous compounds may occur. Visibility can be impaired several miles downwind of the fire depending on the intensity of the fire and the weather. This is potentially dangerous when mines are located near major roads as is the Spring Creek mine, which is 2 miles from Highway 314. Since coal fire plumes travel close to the ground, a fire would produce acute fumigations of living organisms, seriously damaging vegetation.

The air quality of the region would also be impacted by two other activities: (1) the transport of the coal via unit-train, and (2) the increase in population due to coal development. Not only would the unit-trains emit gaseous and particulate pollutants from the diesel engines, there would also be a loss of about 0.0002-0.42 percent of coal dust from open coal cars (Paulson and others, 1976; Nimerick and Laflin, 1977). The monthly dustfall due to coal dust loss along the railway corridor from Spring Creek south to Sheridan could range from 0.03 tons/mi² to 70 tons/mi². The latter would be in violation of the Montana guideline for dustfall (15 tons/mi²/3 months).

On a regional scale, air quality impacts from population influx associated with the Spring Creek mine may equal or even exceed the impact due to the proposed mining operation. Temporarily, a construction camp housing 220 employees would cause increased vehicle traffic on dirt roads, and create exposed, bare areas for a trailer court. The Spring Creek mine would permanently employ 253 people, with an ancillary population of 734 persons in the Sheridan area. (See Socioeconomic Impacts.) The particulate and gaseous emissions associated with roughly 1,000 people is shown in table III-1.

2. Biological Air Quality Impacts

a. Deposition of dust on plant and soil surfaces

Dustfall, as measure of total deposition of particulates on the ground, could increase fourfold above a baseline of about 10 tons/mi²/month in areas of relatively high surface roughness (trees or hills) and in areas adjacent to the Spring Creek mine. The overburden and coal components of

TABLE III-1.--Estimated uncontrolled atmospheric emissions at the Spring Creek mine based on a coal production of 10×10^6 tons/year

[Values are in tons per year]

Source	Particulates	SO ₂	NO _x	CO	HC	HCN	Aldehydes	Organic acids
Mining (all operations) ¹ ----	21,122	--	--	--	--	--	--	--
Population increase-----	60	70	170	340	130	--	--	--
Internal combustion engines:								
Mine vehicles	28	30	409	144	105	--	--	--
Coal trains--	16	36	237	84	60	--	3.7	4.2
ANFO explosives-----	(²)	--	6	68	--	0.2	--	--
Total-----	21,226	136	822	636	295	0.2	3.7	4.2

¹For details concerning uncontrolled particulate emissions from mining operations see appendix D-3.

²Unknown.

dust coming from this mine would contain higher concentrations of the elements sodium, zinc, nickel, lead, strontium, and to a lesser extent cadmium, fluorine, molybdenum, and selenium. The solubility and form of these trace elements in overburden and coal is unknown. The alkalinity of the soil would probably render any soluble trace elements unavailable to plants, except for molybdenum, which becomes more soluble under such conditions. Plants which can absorb minerals directly through leaf surfaces, or actively dissolve elements out of deposited dust, may accumulate toxic levels of some trace elements. (See discussion of lichens in Vegetation Impacts.) Animals may also be able to dissolve these trace elements in their digestive systems.

Only in areas of extremely high dust deposition may the physical accumulation of dust on leaves or the soil surface be expected to induce changes in microclimate (early snowmelt, increased leaf temperature), changes in plant metabolism, and changes in plant community structure. (See Vegetation Impacts.)

b. Wildlife and domestic animals

Long-term ingestion of dust particles containing trace elements may adversely affect bacteria responsible for cellulose digestion in cattle. These elements may also accumulate in the bones and body tissues. Increased ingestion of molybdenum (either accumulated in or on the vegetation) could cause molybdenosis in cattle (Erdman and others, 1978). Dust particles on vegetation may also wear down the teeth of foraging animals (Lillie, 1970).

The increased dust on soil and vegetation may disturb respiratory functions in cattle due to inhalation deposition and retention of the particulate in the gas exchange regions (alveoli) of the lungs (Lillie, 1970) and may lead to increased incidence of respiratory disorders (DHES, Public Hearing, March 11, 1978).

c. Terrestrial insects

Trace elements tend to accumulate in insects, especially at the higher trophic levels. Many of these elements are toxic at low concentrations, depending on insect size, species, mobility, and feeding or behavioral patterns. Honeybees may be the most susceptible of animals to fluoride, arsenic, lead, copper, zinc, phosphorous, mercury, cobalt, and cyanide. It is believed that honeybees and other pollinators may accumulate these elements from pollen. This makes honeybees very susceptible targets for trace element toxicity even when these elements are found at very low levels in vegetation and soils (Bromenshenk, 1978).

Soil inhabiting insects may also be poisoned by trace element deposition on the soil surfaces (Bromenshenk, 1978).

d. Human effects

Dust generated by mining activities at the Spring Creek mine could have detrimental effects on mine employees and their families, as well as on others who live within range of air-borne particulates carried from the minesite. Based on cited studies of respiratory diseases among people who work and live in unusually dusty environments, Bergren (appendix D-4) has described the occurrence of three common pulmonary disorders: silicosis, pneumoconiosis, and industrial bronchitis. In addition to the contraction of lung disease by direct inhalation of dust, it is suggested that chronic bronchitis contracted by miners may have bacteriologically infectious aspects that can be passed on to families or others through contagion.

Particles of size 0.5-5.0 microns are termed "respirable" and are capable of causing lung disease if inhaled in sufficient quantities over a long period of time. Although lung disease has not been recorded among coal miners in southeastern Montana, to the authors' knowledge, large-scale surface mining is still a relatively recent activity. Exposure to mine-derived dust may, however, prove to be detrimental over the long term.

E. SOILS

1. Reclamation

If the Spring Creek permit area is mined, the soils and the ecosystems based on them would be destroyed. After reclamation, if successful, ecosystems in the permit areas would be less stable and less diverse, causing long-term impacts on both quantity and quality of vegetative production. This would also impact animal populations dependent on diverse plant communities.

Due to the paucity of mitigatory measures (chapter VIII, Alternate mitigations, Soils) successful reclamation would be unlikely under the proposed mining and reclamation plan, for the following reasons:

Soil Salinity: the company proposes to salvage "topsoil" material having electrical conductivity (EC) values up to 8.5 mmhos/cm (State guidelines suggest limiting EC values to 4 to 6 mmhos/cm). Such high soluble salt contents have been demonstrated to cause dramatically reduced germination and yield rates (over 50 percent) in forage species even under otherwise ideal conditions (Richards, 1954). Germination rates and seedling survival are more severely impacted by soil salinity than are the yields of established plant communities. Therefore, high salinity levels which are tolerable in native range would be extremely detrimental to reclamation efforts in the same region. This situation has been demonstrated in Montana (Neil Harrington, Dept. of State Lands, personal communication).

Sodic Overburden: the company makes no provision to effectively bury the highly sodic overburden material which dominates the permit area, especially in the eastern and central portions. Sodic overburden has been demonstrated to contaminate 12 inches of non-sodic "topsoil" material by upward migration of sodium over a period of 3-5 years (Agricultural Research Service and North Dakota Agricultural Experiment Station Staff, 1977). Excess sodium causes dispersion of soil particles, leading to structural instability, reduced infiltration and permeability, increased susceptibility to water erosion, and surface crusting. For vegetation, this means increased mechanical resistance to seedling emergence and root elongation, and reduced water availability. The net result is increased mortality. The combination of saline and sodic conditions serves to compound the problem and the likelihood of reclamation failure.

In assessing the probable success of reclamation at any given site, it is essential to consider experience at existing mines in terms of the prevailing physical and chemical conditions at the respective sites. For example, naturally revegetated abandoned mine spoils at Colstrip more than 50 years old are frequently cited as evidence that reclamation is relatively simple and effective in the region. Unfortunately, such results cannot be transferred to Spring Creek because of significant

differences in soils, overburden, and climatic characteristics. Likewise, results at West Decker, where conditions are similar, reflect a maximum of three growing seasons and cannot be assessed for success over a longer period despite the relatively intense management applied at that site.

2. Site Specific Problems

The specific characteristics of soil and overburden at Spring Creek include the following:

- The extensive, deep Colbar and Kimlen soil series which would provide the bulk of "topsoil" salvage are excessively saline (over 6 mmhos/cm) below a mean depth of 32 inches.
- Should the company proceed with the salvage of saline soil materials, much (up to 50 percent) of the postmining surface would be saline, with the results (soil salinity) discussed above.
- If the applicant is prohibited from salvaging these saline soils, the average depth of "topsoil" material would be reduced 50 percent, from 26 to 13 inches.
- The overburden located in the eastern half of permit area has an average sodium-adsorption-ratio (SAR) of 29.6, while the western half averages 16.6. (State guidelines cite a limit of 12 for reclamation materials.)
- The company prefers to cite, and use, the lower exchangeable sodium percentages (ESP), which average 14.6 percent for the entire permit area and range up to 47 percent.
- The State of Montana has not issued guideline values for ESP, but the literature does provide a limit of 12 to 15 percent as a division between sodic and non-sodic soils (Agricultural Research Service, 1977; Richards, 1954).
- Published levels affecting soil development are lower, ranging from 7.5 to 5 percent (Russell, 1961; Dregne, 1976; Omodt and others, 1975).
- The ESP value of 5 is cited by Omodt and others, as capable of causing dispersion in material placed on the surface of mined land.
- Should the company be permitted to place overburden spoils without regard to sodium status, a high percentage of the mined area would become sodic over a period of time ranging up to 10 years.
- A combination of saline and sodic spoils would render reclamation efforts ineffective.

In addition to sodium and salinity problems, the company's mine plan does not address the long-term (post-bonding period) implications of a potential molybdenum-induced copper deficiency disease (molybdenosis), induced by high molybdenum levels and/or low copper:molybdenum ratios. This condition could lead to weight loss and possibly death of cattle grazing primarily in reclaimed areas (Erdman and others, 1978). The applicant's consultant suggests various procedures which would treat the problem but not solve it.

3. General Mining Impacts

A number of chemical and physical impacts that would occur at any surface minesite in the semiarid West would constitute a long-term commitment of soils and related plant and animal resources. The effects of these impacts include:

- . A short-term (2-3 years) release of nutrients, followed by a net reduction in plant-available nutrients, especially phosphorus and nitrogen.
- . Soil microorganism populations are disrupted, as are soil microclimates, resulting in drastically reduced decomposition rates of dead plant material. Nutrients are not released, and the cycle is incomplete.
- . Typically, these conditions result in dramatic decreases (as much as a 75 percent decrease) in vegetative productivity about 5 years after the start of reclamation procedures.
- . Reduction of infiltration rates as a result of loss of soil structure, particle dispersion, increased bulk density, and surface crusting.
- . Reduced plant-available water, as a result of reduced infiltration rates and loss of structure.
- . Reduced soil diversity in chemical, physical, and topographic aspects.
- . Long-term instability, due to very slow rates of soil development and topographic uniformity.

These impacts constitute a fundamental alteration of range and agricultural resources for the foreseeable future.

Specifically, this entails a two to fivefold or greater increase in erosion rates (Lusby and Toy, 1976), decreased plant community diversity and productivity, and altered plant community composition related to soil characteristics and diversity. This directly affects quality of livestock forage and wildlife habitat throughout the year. (See chapter III, Vegetation and Wildlife). In addition, decreased soil/ecosystem

stability magnifies the impacts of detrimental characteristics of "topsoil" and overburden spoil materials beyond the influence which would be the case for undisturbed range.

4. Postmining Management

During the course of mining, much should be learned about what can and must be done to effect successful reclamation. If the Spring Creek permit area is mined, by the time the final acreage is released from bond the company would have 35 or more years of experience. Assuming that the company would be induced to modify the mining and reclamation plan to avoid the problems of saline and sodic materials prior to mining, the short and medium term reclamation could be successful. But, in the long-term, much is left to chance.

Soil development is slow in the semiarid region in which Spring Creek is located, where soils are classified as poorly developed Entisols even after several thousands of years. The more fully developed Aridosols and Mollisols may date back to the late Pleistocene, and have been influenced by a range of climatic regimes, some wetter and cooler than those experienced in the more recent past.

Slow rates of development indicate long-term instability of reclaimed mine spoils. It is possible that the Spring Creek area would be subject to some form of mismanagement through grazing, agriculture, recreation, or development during this extended period of instability. Disturbance or compaction could easily accelerate erosional processes, reverse plant succession, and culminate in areas of very low productivity.

F. VEGETATION

The most serious impact on vegetation would be the long-term elimination of the vegetation mosaic and species diversity and a reduced potential productivity for several decades. Loss of diversity and reduced productivity would be due to the permanent alteration of the requisite edaphic, topographic, geologic, hydrologic, and microclimatic conditions for the maintenance of the vegetation. This would seriously reduce the capability of the reclaimed vegetation to provide suitable wildlife habitat, watershed cover, and livestock forage and would reduce the esthetic value of the area. (See appropriate sections.) Mining reclamation must comply with Federal and State regulations; however, compliance alone does not insure success. The company's mine plan does not address the long-term (post-bonding period) implications of a potential molybdenum-induced copper deficiency disease which could afflict livestock by their ingesting plants (particularly legumes, favored in reclamation seed mixes) rooted in overburden materials.

For the first several years after reseeding reclaimed areas would have a relatively uniform cover of grasses, forbs, legumes, and weedy species (table I-3). Existing seed in the reclaimed topsoil would contribute only slightly to the new vegetation since most of the viable seed would be

killed by stockpiling and/or too deep burial during redistribution of the topsoils. Invading annual weeds would be relatively dense the first few years, then would decline sharply as perennial species crowd them out. Possibly within a decade, reseeded areas would have developed a self-sustaining, adequate ground cover. In the event of severe drought, density and abundance of species would probably diminish markedly and would have to be reseeded (prior to the release of the reclamation bond) to comply with State and Federal regulations. Erosion of redistributed topsoil along graded highwalls (about 145 acres total) and burial of plants by deposition along the base of reclaimed highwalls would also necessitate occasional reseeding.

A decade or two after reseeding, heterogeneous vegetation patterns would possibly begin to appear in the heretofore uniform vegetation. Such patterns would likely develop along the mine boundaries and in the earliest reclaimed areas by encroachment of vegetation from adjacent undisturbed areas, as well as in localized microsites within the mine area. A wave of plant succession would gradually continue across the reclaimed area. By the time the mine would be abandoned, therefore, incipient vegetation patterns would possibly be recognizable in the earliest reclaimed areas.

Present technology has failed to demonstrate an ability to reestablish ponderosa pine, Rocky Mountain juniper, deciduous trees, and many shrubs in reclaimed mine areas of the Northern Great Plains. Several plant species would be precluded from reestablishment of the mine area, particularly those which require specialized microenvironments for their maintenance. Ponderosa pine would undoubtedly be lost as a self-sustaining population for the long term and might be irretrievably eliminated because the requisite moisture, soil, and bedrock conditions would be irreparably destroyed. Further, the success of establishing this species in areas of marginal moisture has not been demonstrated. Rocky Mountain juniper would also be lost from the reclaimed area for the long term. This species, however, would be more likely to become reestablished since it is less dependent on those conditions which support ponderosa pine.

Destruction of the discontinuous alluvial aquifer on South Fork would permanently preclude the reestablishment of those deciduous trees which require a perched water table. Other species such as the deciduous shrubs of the riparian community would be lost for the long term (perhaps several decades), until natural encroachment of these species occurs. Competition with grasses and forbs would delay this encroachment for an unknown period of time.

Reclaimed vegetation and native vegetation close to the proposed mine and facility locations would be impacted to varying degrees by such disturbances as dust, off-road vehicle travel, and fire. Most of the impacts would be of short duration and essentially would cease with abandonment of the mine.

Fugitive dust from mine spoils and coal has chemical and physical properties that may adversely affect local vegetation (see Air Quality, chapter III). Dust from sodic overburden can induce an "alkaline dust effect" on plants, which may decrease the number and species of lichens (Gilbert, 1976) and vascular plants (Brandt and Rhoades, 1972), as well as decreasing shoot length in deciduous shrubs and trees (Brandt and Rhoades, 1973) and needle length in conifers (Darley, 1966). Lichens accumulate trace metals faster than any other plant in amounts which correlate closely with levels in dustfall from the pollution source (Jenkins, 1966). Although the exceedingly high trace element concentrations that may occur are not toxic to the lichen, it poses a potential threat to wildlife foraging on those plants. Trace element deposition on the soil surface could inhibit soil nitrification (Liang and Tabatabai, 1978).

Coal dust which accumulates on plant and soil surfaces may change their microclimate, decreasing plant productivity. Leaf necrosis, decreased pollen germination, decreased fruit production, and in some severe cases death of the plant, have been associated with deposition of coal dust on vegetation (Auclair, 1976; Rao, 1971). The latter studies suggest that both the chemical and physical presence of coal dust on plant and soil surfaces can eliminate sensitive members of the plant community, altering species composition and frequency.

Off-road vehicle travel, in addition to causing dust, would create significant localized soil compaction. This compaction would result in severely reduced vegetation productivity in vehicle tracks; thereby, inducing potential rill and gully erosion (chapter III, Geomorphology and Recreation). During the mine life, a slight increase in fire frequency would be due to mining-related activities; however, most fires would probably be restricted to a few acres because the company would provide fire-fighting equipment at the minesite.

1. Rare and Endangered Species

There are no known rare or endangered plant species in the area to be affected by the proposed mine.

G. WILDLIFE

Impacts on wildlife arising from the proposed Spring Creek mine would be more severe than any of the other existing or currently proposed coal strip mining operations in southeastern Montana. These impacts are anticipated because of the destruction of habitat which supports a high diversity of wildlife species and which supports large concentrations of several wintering species. A greatly reduced carrying capacity would result because of changes in vegetation and topography; therefore, wildlife populations on the entire permit area would be destroyed or displaced

during mining and would not be expected to return to premining levels for a long period of time. Adverse impacts would be of major significance on a site-specific basis, and somewhat less significant considering the larger Decker subregion as a whole. Within the 4,420-acre permit area the topographic relief would be destroyed and the soils and vegetation disturbed to varying degrees (chapter III, Topography, Vegetation, and Soils). Current mining and reclamation plans cannot restore these aspects of wildlife habitat; hence, impacts to wildlife would be perpetuated.

1. Habitat

Mining would result in the loss or disturbance of about 4,420 acres, all of which is classified as wildlife habitat (table II-18). The habitats containing the vegetation types, such as ponderosa pine and big and silver sagebrush, and other shrubs, such as shadscale, saltbush, and skunkbush, would be lost during mining. Reclamation efforts to date have not successfully demonstrated that these habitat types can be reestablished on a self-regenerating or self-sustaining basis.

2. Large Mammals

a. Antelope

Antelope would be the mammal most severely impacted by the proposed operation because of a greatly reduced carrying capacity caused by the physical loss and impeded utilization of the major antelope use areas (fig. II-11) due to mining and associated facilities. The most severe impacts would be on the northern half of the mine area and along the railroad and access road corridors. Blockage of migration routes and disruption of local movement patterns are expected to result in the impeded utilization of otherwise suitable habitat. Seasonally important areas may become inaccessible, thereby potentially eliminating a critical component (wintering or kidding areas) necessary to the life cycle of antelope. The loss of wintering habitat would have adverse impacts on antelope far removed from the minesite.

b. Mule deer

The proposed Spring Creek mining activities would greatly reduce the carrying capacity of the area and thereby inflict substantial adverse impacts on mule deer which use the area year-round and those which use it seasonally. The entire permit area is classified as mule deer habitat. As with antelope, the loss of wintering habitat would have severe adverse impacts on mule deer populations far removed from the minesite (perhaps as far as 25-30 miles) and on the local population. Impacts to mule deer are expected to be the greatest in the southern half of the mine area, with somewhat less severe impacts arising along the railroad corridor and the northern portion of the permit area. (See fig. II-13.)

Major north-south and east-west migration routes between major use areas and local movement would be blocked by mining activities and the railroad corridor. Probably the most serious impact of this nature would be the potential isolation of wintering or fawning areas from habitats used during other seasons.

c. White-tailed deer

Impacts to white-tailed deer would be minimal since these deer utilize the permit area very infrequently.

3. Other Mammals

Mining would progressively destroy small mammal habitat on the minesite and all ancillary facility areas. Small mammals would be almost totally eliminated from disturbed areas during mining; however, some species populations would probably return to near premining levels after revegetation. Mining would eliminate the ponderosa/juniper and sagebrush habitat in which small mammals are currently most abundant, and revegetation would create dominantly grass habitat, in which they are currently least abundant. Thus, all existing species would not approach their premining population levels for at least several decades. In addition, mining would eliminate most escape cover (rock crevices and dense stands of shrubs) for cottontail rabbits; hence, onsite populations would probably never attain their premining levels. Lowered small mammal abundance would adversely affect many predator species (mammals, birds, reptiles) which depend on small mammals for prey.

4. Upland Game Birds

Of the four species of upland game birds observed on the area, sage grouse would suffer the most severe adverse impacts. The greatest adverse impact would be the loss of the most important breeding area and critical wintering habitat in the Spring Creek vicinity. The "Upper Divide" breeding site (fig. II-14) accounts for a majority of the known sage grouse production in the Spring Creek vicinity, and its loss would have severe adverse impacts on the surrounding sage grouse population.

The most significant adverse impact on sage grouse occurring from the proposed action would be the loss of critical wintering area within the mining area. This "key sage grouse wintering area" provides the food and cover necessary for sage grouse survival during severe winter months, suggesting that sage grouse migrate to this particular wintering area from areas far removed from the minesite. Consequently, loss of this critical habitat would adversely affect the total sage grouse population in the Spring Creek vicinity.

Sharp-tailed grouse populations would decline primarily from the elimination of about 2,750 acres of winter range in sagebrush/grass and

habitat and secondarily from the elimination of dance areas, one in the mine area and a second near the railroad loop, and possible disturbance of several others near the mine (fig. II-14).

Ring-necked pheasants would probably not be significantly impacted by the proposed action because of their scarcity in the Spring Creek vicinity. Gray partridge may suffer some adverse impacts because of permanent loss of wintering habitat, sagebrush/grass habitats in particular.

5. Raptors

About 13 raptor nesting sites are located in areas where direct or indirect disturbances would likely preclude their use, because ponderosa pine trees and sandstone cliffs, the two most important breeding habitats for raptors in the mine area (Lockhart, 1976), would be disturbed. Raptor species which would be adversely affected would include: long-eared owls, great-horned owls, golden eagles, kestrels and red-tailed hawks. As noted in the discussion on small mammals, the habitat types with the greatest abundance of prey animals for raptors would be lost, and reclamation of those habitats has thus far not been successful.

6. Songbirds

Mining would markedly reduce songbird populations and change the species composition on the disturbed area through long-term elimination of the varied habitat types, probably with concomitant reduction in the numbers and varieties of insects that the birds depend on. Impacts would be confined largely to the 4,420 acres of habitat actually changed by mining and would thus not be of great significance on a subregional basis. Mining would eliminate 2,260 acres of sagebrush/grass habitat used by Brewer's and vesper sparrows, and that habitat loss would probably last for decades. Similarly, at least 147 acres of sandstone outcrop and ponderosa pine habitat used by chipping sparrows, cliff swallows, loggerhead shrikes, rock wrens and Say's phoebes would be permanently eliminated.

7. Amphibians and Reptiles

Adverse impacts from the proposed action on amphibians would likely affect primarily the reproductive requirements of frogs and toads. Loss of existing wetlands used as breeding and rearing areas would adversely impact frogs and toads for the life of the mine; however, suitable areas for their reproduction are expected to develop following mining. Snake denning areas (rock crevices) would be lost to mining, and the abundance of their food (small mammals and insects) would be permanently lowered.

8. Endangered Species

There would be no impact to endangered wildlife species.

9. Fisheries

There would be no impact to fisheries resulting from the proposed operation.

H. SOCIOLOGY

If the proposed Spring Creek mine is permitted, it would contribute additional impingements on the quality of life for those living in the Birney-Sheridan area. This area includes the natural rural communities of Birney and Decker (fig. II-17) and extends south to include the urban areas of Sheridan County. Those living within the southeastern panhandle of Big Horn County would primarily be impacted by the actual mining activity. Those living in Sheridan would be impacted primarily through new demands placed on the community and on individuals resulting from a large number of new people moving into the area. Some people would benefit through immediate economic gains; however, the general social and psychological well-being of the area can be expected to decline unless mitigated through creative and responsible planning. Although the addition of the Spring Creek mine would contribute to an already impacted area, the cumulative impacts of all the mining and related activity would have a far greater impact on local society.

1. Population

The location of the proposed Spring Creek mine would have a major effect on population characteristics in Sheridan County, Wyoming and a negligible effect in Big Horn County, Montana, where the mine would be located. Because of the residential and trade patterns that have been established in Big Horn and Sheridan Counties, the primary towns affected by mining-induced population growth will be towns in Sheridan County, and more specifically the town of Sheridan. The town of Hardin, in Big Horn County, would experience little if any population growth from the Spring Creek mine.¹

Population would increase by 2,882 between 1978 and 1990 (27 percent) in Big Horn County (the same as the base increase without the Spring Creek mine) while Sheridan County would experience an increase in population of 7,171 (31 percent) by 1990. (A 31 percent increase with the Spring Creek mine as opposed to 28 percent or 6,327 without the mine). The city of Sheridan would grow by 46 percent from 1978 to 1990.²

¹It was assumed that miners employed at the new Spring Creek mine, as well as those employed at Decker mine, would continue to reside in Sheridan County. The only miners residing in Big Horn County are assumed to be from the Westmoreland mine.

²The population value for the city of Sheridan in 1978 is somewhat higher relative to the model computation.

Table III-2 shows the estimated population changes that would occur in Big Horn and Sheridan Counties. It is important to realize that major changes will occur in Sheridan County's preponderance of non-Indian residences. The Indian population in Sheridan County is not expected to increase from its current very small percentage of the total population. The Indian population in Big Horn County will remain basically very large. (Refer to chapter II, Population.)

TABLE III-2.--Population projections with addition of
Spring Creek mine at 10 million tons per year*

Year	Big Horn County	Sheridan County	Sheridan
1978-----	10,609	22,487	15,734
1979-----	10,600	23,045	16,292
1980-----	10,694	23,839	17,086
1981-----	10,985	23,737	16,984
1982-----	11,160	24,122	17,369
1983-----	11,341	24,541	17,788
1984-----	11,533	25,987	18,234
1985-----	11,733	25,458	18,705
1986-----	11,975	26,031	19,278
1987-----	12,222	26,627	19,874
1988-----	12,474	27,249	20,496
1989-----	12,729	27,891	21,138
1990-----	13,491	29,658	22,905

* Table III-2 has been revised from the draft.

Population changes induced by the establishment of the Spring Creek mine would be relatively minor; however, most of the social impacts would occur in areas in Sheridan County, where they would be significant because the area is already under stress. Rural areas in Montana would experience population effects primarily as a result of increased work-related and recreational people moving about the area. Little settlement is expected in the rural areas of Montana from the Spring Creek mine related population.

2. Social Organization

The cumulative impacts to social organization that would result from approval of new mines, including the Spring Creek mine, are discussed in terms of the key components of the quality of life: social well-being and psychological well-being.

a. Social well-being

Social well-being would be affected by change in the institutions and groups which reflect community values, goals, and everyday activities. The changes would be greatest in the Sheridan urban area, but change would also occur in the rural communities of Big Horn County.

Changes noted by Gold (1974a) include shifts in the selection of friends, strains in communicating with friends and neighbors of long standing, a shift in the established power structure from the ranchers to the new mining industrialists, the need to live with constant and increased uncertainties for which planning is virtually impossible, a keen interest on the part of some merchants and businessmen in immediate monetary gain, the need to accommodate the invasion and requirements of newcomers who subscribe to foreign life-styles and value systems, and loss of a sense of community. These existing conditions suggest that a state of "simple anomie" (Merton, 1968) already exists in the Birney-Sheridan area. Increased mining activity, expanding at its projected pace, would concentrate and exacerbate this condition.

Social well-being can be evaluated in terms of the five categories described below (Fitzsimmons and others, 1977). Although there is a lack of data with which to examine all components of these categories in depth, it is possible to examine each in a general sense.

THE VIABILITY AND STABILITY OF COMMUNITIES in Big Horn and Sheridan Counties would be changed as large numbers of new residents move into the area. Community services and facilities would be the first to be affected. There would be a period of a few years or more between the onset of increased demands for services and facilities and expansion to meet the new needs. The duration of this lag period would depend on the timing of mine openings, the responsiveness of local government, and on the availability of new tax revenues. Since the new mines would be located in Montana, new revenues would depend mostly on increased property valuations, sales taxes, or State or Federal aid. Tax burdens could be increased for long-term residents.

THE ACHIEVEMENT OF ECONOMIC STABILITY AND IMPROVED PERSONAL INCOME would be reduced for some and enhanced for others.

New jobs would be created at the mines and in Sheridan County. Competition for skilled labor would cause wages to increase in an area where they have traditionally been low. This in turn would boost prices. Workers with the necessary skills would benefit, while unskilled workers and agricultural employers might not benefit.

Merchants in the area would benefit initially from higher prices and increased demand. New businesses and chain stores might locate in the area, however, providing price competition and perhaps replacing some existing firms.

Housing would become more expensive and would place a burden on people with fixed or low incomes.

POPULATION DISTRIBUTION WOULD CHANGE. As mine-related growth increases, the desirability of Sheridan as a regional retirement center appears to decrease. As young unmarried males move into the area, the ratio of males

to females would increase. Schools would become more crowded due to an increase in the number of young families with school age children.

As Sheridan becomes more crowded, it would become harder for people to ENHANCE THE SECURITY OF LIFE AND HEALTH. Noise, air pollution, crowding, mud, water pollution, and littering would increase, thus lowering the beauty of the town and the healthy nature of the environment. Crowding and an increase in pollution, where mitigation is unlikely, tends to increase the probability of mental and physical illness (Cassel, Patrick, and Jenkins, 1960; Leighton, 1974). The expected increased crowding in housing may also affect mental and physical health.

Since formal opportunities for recreation are primarily limited to movie theaters and bars, newcomers use local bars as a major mode of relaxation. There are commonly fights and incidents which make the bars less desirable for those who formerly frequented them and thought of them as "their own" neighborhood bars. Such problems can be expected to increase.

LOCAL GOVERNMENTS WOULD BECOME LESS STABLE as the influx of additional permanent residents shifts political power away from its traditional base. Permanent mine workers, ancillary employees, and their families will be more likely to take part in local politics because their jobs are more permanent than those of construction workers.

b. Psychological well-being

Approval of the proposed Spring Creek mine would contribute to a decrease in the psychological well-being component of the quality of life. Psychological well-being is a function of an individual's interaction and the quality of relationships with the social and physical environment. Approval would also contribute to the trend toward the breakdown of traditional social organization.

The breakdown of social organization interferes with the process of individuals meeting what Maslow (1968, 1970) calls growth needs. Failure in personal growth results in "neuroses" and "pathologies." The decrease in a sense of worth and meaning and the interference with personal growth is manifest in what Kohrs (1974) has described as the "Gillette Syndrome." This syndrome refers to the increasing incidence of drunkenness, divorce, delinquency, depression, and even suicide in rural western boomtowns. Although the description above is not indicative of the present condition in the Birney-Sheridan area, there are increasing indications that a similar trend is developing in the region.

Most of the newcomers to Sheridan County would tend to be temporarily isolated from the existing community. Families of construction and mining workers who settle in mobile home parks would be most severely affected. There are limited social, cultural, and educational opportunities for the

wives of construction workers. Children whose parents frequently change job locations often have trouble with school. Child abuse, juvenile delinquency, and alcohol and drug abuse could be expected to increase.

Professional help with mental health, child guidance, and alcohol and drug abuse is available in Sheridan, but services are severely strained now. Increasing demands for these services could not be met without substantially increased budgets and staff.

Subtle impacts on psychological well-being are caused by frustrating situations, such as increased noise and traffic, waiting in line where one never had to wait before, and a decline in the quality of services. Situations such as these are already occurring in the urban portions of the study area. Information on the existence of similar problems in the rural areas and on the Crow and Northern Cheyenne Indian Reservations is not available.

I. ECONOMICS

Approval of the proposed Spring Creek mine would cause impacts through changes in employment, population, public finance, and income. With an increase in economic activity, indirect impacts and would occur to community services and social organization.

1. Employment

Mine plan approval would generate additional employment at the mine-site in Big Horn County. Because of the lack of urban development in Big Horn County, it is assumed that these miners would reside in Sheridan County. Construction employment would commence in 1979 with the establishment of the mine facilities and would end in 1980. At peak construction, 480 workers would be employed. Mining employment would begin before the end of the construction period in 1980 and continue throughout the life of the mine. It is estimated that a force of 253 miners would be required to mine the 10 million tons of coal per year. Table III-3 depicts the expected number of miners, by residence, for both counties between 1978 and 1990. The majority of these miners would reside in Sheridan County,¹ although many would be employed in Big Horn County.²

¹Much speculation has been going on in southern Big Horn County concerning a new town, but at present, plans have not been completed. Table III-3 includes mine construction workers.

²The majority will be employed at the Spring Creek and Decker mines in Big Horn County, Montana.

TABLE III-3.--Mine employees residence (1978-90)

Year	Big Horn County	Sheridan County	Year	Big Horn County	Sheridan County
1978-----	195	864	1985-----	210	949
1979-----	153	934	1986-----	210	949
1980-----	153	854	1987-----	210	949
1981-----	210	949	1988-----	210	949
1982-----	210	949	1989-----	210	949
1983-----	210	949	1990-----	210	949
1984-----	210	949	1991-----	210	949

Table III-4 compares the employment changes in Sheridan County with and without additional employment at the Spring Creek mine. The increase in total employment in Sheridan County by 1990 would be 451 workers if the proposal were approved. Ancillary employment would increase by 205. However, Big Horn County shows no employment changes in the base, ancillary, and total employment since the workers from the Spring Creek mine would reside in Sheridan County.

The estimated increases in employment resulting from the establishment of the Spring Creek mine would result in higher population and income in Sheridan County. Estimates indicate that there would be a migration of people from Sheridan following the mining construction. The out-migration would be only a temporary pattern. (See appendix I.)

The employment/population ratio (the number of people employed divided by the total population) for both counties will increase during the early 1980's, but will decrease to the 1970 levels in the latter part of the decade. Approval of the Spring Creek mine would have an insignificant effect on the overall ratio over a long period of time. (See appendix I for these county estimates.)

2. Income

Increases in employment related to the Spring Creek mine would cause an increase in total personal income in the two-county area. More specifically, the majority of the annual payroll received by operational workers would be spent in Sheridan County. It is highly probable that during construction, much of the construction payroll would be spent in Sheridan County also. Incomes in Sheridan County would be approximately doubled. This secondary income effect would continue throughout the life of the Spring Creek mine.

Other estimates (appendix I, table C) based on the analysis of the Coal Town II¹ model projections indicate that over the life of the Spring

¹Coal Town II model, Montana State University, Bozeman, Montana.

TABLE III-4.--Employment projections, Big Horn and Sheridan Counties, (1978-90)*

Year	Big Horn County			Sheridan County		
	Base employment	Ancillary employment	Total employment	Base employment	Ancillary employment	Total employment
Baseline employment without Spring Creek mine**						
1978---	2,244	2,264	4,508	4,376	6,248	10,624
1979---	2,202	2,346	4,548	4,167	6,366	10,533
1980---	2,202	2,445	4,647	4,292	6,604	10,896
1981---	2,259	2,573	4,832	4,316	6,832	11,147
1982---	2,259	2,679	4,938	4,340	7,067	11,406
1983---	2,259	2,783	5,042	4,364	7,312	11,676
1984---	2,259	2,889	5,148	4,389	7,567	11,956
1985---	2,259	2,996	5,255	4,415	7,833	12,248
1986---	2,259	3,104	5,363	4,441	8,110	12,551
1987---	2,259	3,213	5,472	4,468	8,402	12,870
1988---	2,259	3,323	5,582	4,495	8,705	13,200
1989---	2,259	3,434	5,693	4,523	9,020	13,542
1990---	2,259	3,546	5,805	4,551	9,347	13,898
Projected employment with Spring Creek mine						
1978---	2,244	2,264	4,508	4,376	6,248	10,624
1979---	2,202	2,346	4,548	4,505	6,511	11,017
1980---	2,202	2,445	4,647	4,447	6,701	11,148
1981---	2,259	2,473	4,832	4,567	6,961	11,528
1982---	2,259	2,679	4,938	4,590	7,209	11,799
1983---	2,259	2,783	5,042	4,614	7,461	12,075
1984---	2,259	2,889	5,148	4,638	7,724	12,362
1985---	2,259	2,996	5,255	4,664	7,997	12,661
1986---	2,259	3,104	5,363	4,689	8,282	12,971
1987---	2,259	3,213	5,472	4,715	8,581	13,297
1988---	2,259	3,323	5,582	4,742	8,893	13,634
1989---	2,259	3,434	5,693	4,769	9,216	13,985
1990---	2,259	3,546	5,805	4,797	9,552	14,349

*Table III-4 revised from draft.

**These data are the same estimates made available in chapter II given that others mines in existence continue without the introduction of the Spring Creek mine.

Creek mine the average ancillary wage will not significantly increase in real terms in either Sheridan or Big Horn Counties. The available evidence does, however, suggest that the average ancillary wage in Sheridan County would be slightly higher with Spring Creek mine.

The majority of the financial benefits resulting from the operation of the mine would be distributed among the businesses in the area, and those involved in the mining and construction sectors. Individuals with fixed incomes (primarily the elderly) and the poor would be in a less favorable financial position, because prices would generally increase more rapidly than would their income during boom conditions. New jobs and high incomes would make it possible for many young people of the local area to remain: lack of opportunity for employment in the past made it necessary for many young people to seek employment in other regions.

3. Fiscal Conditions

With the addition of the Spring Creek mine, State, county, and school district revenues are estimated to increase in Big Horn County. Although the revenue for the town of Hardin is estimated to grow, approval of the Spring Creek mine would not add any additional revenue to the city of Hardin. It is estimated that revenue for the city of Hardin would increase between 1978 and 1990 and that the county and school districts would receive additional funds (table III-5). Revenues to the State of Montana also would increase substantially from the additional taxes generated from the Spring Creek mine. (See table III-5.)

The majority of the negative fiscal impacts would occur in Sheridan County. It is estimated that there would be small differences in the amount of revenue to Wyoming that would result from the approval of the Spring Creek mine. County and school district fiscal conditions are shown in table III-5 for purposes of comparing with and without the Spring Creek mine. These values are only estimates of the county and school districts in Sheridan County experiencing shortfalls. Under Wyoming law, Sheridan County would not face actual deficits as projected. The deficits indicated are the result of the Coal Town II model analysis, which assumes that the mill levy remains constant. The Sheridan County school districts would gain a difference of approximately 300 school children by the year 1990 with the addition of the Spring Creek mine. However, either with, or without the Spring Creek mine, there will be substantial growth in the number of students attending high school and grade school in Sheridan County.

4. Indians and Indian Reservations

If the Spring Creek mining plan is approved, Indian population and the Indian reservations (Crow, Northern Cheyenne) would experience certain indirect impacts. The major impacts would be: (1) increased flow of traffic through the reservations by construction workers and miners traveling to and from the Spring Creek mine for both work and recreational purposes; (2) social and political confrontations would increase because of cultural differences between the Indians and the mine workers; (3) tribal administration

TABLE III-5.--Projected fiscal conditions--a comparative analysis with the addition of the Spring Creek mine,¹ Big Horn and Sheridan Counties, 1978-90

With the addition of the Spring Creek mine													
Big Horn County							Sheridan County						
Year	State revenue	County surplus	School surplus	School chil-dren	Hardin reve-nue per head	State income tax derived from coal mining	State revenue	County surplus	School surplus	School chil-dren	Sheridan reve-nue per head		
1978	33,157,696	584,925	1,099,620	2,785	134	1,240,921	2,920,703	-4,995,746	117,301	6,082	94		
1979	41,856,704	1,182,550	2,550,634	2,783	137	1,341,906	4,642,104	-5,251,832	235,539	6,177	101		
1980	62,451,840	904,096	3,424,281	2,808	143	1,227,172	4,686,206	-5,617,345	-94,374	6,178	100		
1981	86,391,168	1,486,474	5,344,001	2,884	148	1,363,684	5,248,136	-9,340,062	-4,768,031	6,294	108		
1982	96,625,344	2,124,408	7,411,076	2,930	155	1,363,684	5,367,356	-7,039,418	-1,501,524	6,384	106		
1983	109,646,768	2,196,441	7,659,450	2,977	161	1,363,684	5,786,637	-8,882,557	-3,712,742	6,467	111		
1984	116,765,152	2,297,750	7,978,897	3,028	167	1,363,684	6,175,357	-10,122,232	-5,121,022	6,522	115		
1985	122,960,544	2,383,311	8,240,049	3,080	174	1,363,684	6,542,640	-10,838,996	-5,827,830	6,640	118		
1986	129,460,464	2,381,758	8,203,957	3,144	180	1,363,684	6,986,445	-12,444,315	-7,679,437	6,745	122		
1987	135,932,176	2,525,516	8,640,072	3,209	186	1,363,684	7,317,806	-11,781,085	-7,965,836	6,860	124		
1988	143,121,904	2,605,404	8,858,550	3,275	192	1,363,684	7,786,087	-13,634,702	-8,676,830	6,971	128		
1989	150,676,784	2,698,368	9,113,276	3,342	199	1,363,684	8,242,036	-14,547,349	-9,580,545	7,081	131		
1990	160,184,080	2,262,275	7,440,010	3,542	199	1,363,684	12,671,620	-19,891,56?	-15,647,843	7,48?	157		

Without the addition of the Spring Creek mine													
Big Horn County							Sheridan County						
Year	State revenue	County surplus	School surplus	School chil-dren	Hardin reve-nue per head	State income tax derived from coal mining	State revenue	County surplus	School surplus	School chil-dren	Sheridan reve-nue per head		
1978	33,157,696	584,925	1,099,620	2,785	134	1,186,345	2,906,476	-4,978,358	119,701	6,060	94		
1979	41,856,704	1,182,550	2,550,634	2,783	137	856,292	4,511,409	-5,080,560	269,792	5,975	101		
1980	56,173,488	705,776	2,768,750	2,808	143	1,000,131	4,829,540	-8,541,645	-4,083,961	6,041	100		
1981	70,975,984	999,209	3,728,475	2,884	148	1,000,131	5,039,452	-7,829,728	-2,949,402	6,114	108		
1982	73,475,824	1,392,383	4,984,046	2,930	155	1,000,131	5,353,567	-8,300,606	-3,361,428	6,188	106		
1983	85,352,352	1,430,256	5,119,164	2,977	161	1,000,131	5,688,359	-9,030,105	-4,112,156	6,263	111		
1984	91,235,440	1,495,511	5,319,074	3,028	167	1,000,131	6,035,880	-9,752,543	-4,847,053	6,341	115		
1985	96,130,416	1,543,095	5,454,315	3,080	174	1,000,131	6,395,248	-10,419,168	-5,498,763	6,420	118		
1986	101,263,808	1,501,450	5,285,295	3,144	180	1,000,131	6,832,805	-11,991,832	-7,317,698	6,524	122		
1987	106,292,800	1,603,121	5,581,873	3,209	186	1,000,131	7,158,706	-11,333,901	-7,587,934	6,622	124		
1988	111,965,168	1,638,619	5,653,174	3,275	192	1,000,131	7,617,289	-13,122,602	-8,261,736	6,724	128		
1989	117,923,856	1,684,720	5,752,541	3,342	199	1,000,131	8,064,088	-13,991,168	-9,119,688	6,825	131		
1990	125,754,704	1,199,346	3,919,876	3,542	199	1,000,131	12,463,632	-19,105,472	-14,897,783	7,101	157		

¹Estimates made from the Coal Town II Model, Montana State University, Bozeman, MT

of public services on the reservation would be complicated and become more expensive because of the need for game wardens, etc.; (4) Indian incomes would probably lag behind miner incomes as miners and construction workers would receive nationally established union wages.

No additional employment, income, or population changes would be expected to occur on the reservations as a result of the Spring Creek mine being established.

J. COMMUNITY SERVICES

The impact on the entire spectrum of community services would be radically different if the proposed new town is built at Decker. However, since there is no assurance that the town will ever be built, this chapter will assume existing conditions.

The introduction to the chapter II "Community Services" section outlined a group of problems common to all community services. If the Spring Creek mine is permitted, community services that have currently reached the upper carrying capacity limits would become stressed to an even larger degree. The school district with capacity may remain untouched while the overloaded district must cope with hundreds of new students. The cost for these developments must be paid by revenues generated from property tax. In many cases the additional development costs present unfair burdens on the local taxpayer.

1. Housing

Since the existing trends in housing in Sheridan County have been induced largely by coal development, it is most probable that similar trends will continue. Based on trendline population projections, Sheridan Area Planning Agency (SAPA) expects the number of needed housing units in 1980 to be 8,188, in 1985 to be 9,955, and in 1990 to be 11,870.

The vacancy rate of 0.9 percent in Sheridan will continue or decline even further. The vacancy rates in Ranchester and Dayton would most likely decline further since, relative to Sheridan, there is available housing in the outlying towns.

The construction of single family units would increase. Increasing prices would limit their availability to the more well paid. It is doubtful that the percentage of the single family dwelling (SFD) housing stock would increase much further.

Mobile homes would increase in numbers and as a percentage of the housing stock. The inability of people to wait for housing and the high prices will force many people into trailers.

The multifamily units planned and under construction in Sheridan would raise the number and percentage of such units. For those able to

afford them, multifamily units, if well designed, would be an attractive compromise between mobile homes and single family dwellings.

In some cases the existing owners of older, run-down homes may find it increasingly difficult to spare money for maintenance. Short-term construction residents may have little incentive to upgrade their housing. However, the more permanent employees would probably take much more of an interest in maintaining their housing.

The price of housing would continue its increase. With a rapid increase in demand and extremely low vacancy rates, new and old housing would become increasingly expensive. New housing built under such conditions and in an inflationary area would be increasingly difficult to afford for low income people. Rents, especially, would reflect the monetary demands and would rise.

Existing families, especially those with lower fixed incomes, would be under considerable pressure. Property taxes, rent and mobile home park rent would rise substantially. Some of these families may be forced out of their housing into something more affordable, if it is available. Many of these people may be forced into some kind of housing assistance.

Inflated housing and land values concurrently have a beneficial effect. Landlords are induced to maintain rentals because higher rents can be obtained for maintenance costs.

2. Water

a. Sheridan

The city water system should be adequate for the near term. In excess of \$1.5 million is being spent on improved distribution mains. Depending on the extent and timing of local and statewide development, the system could easily become overloaded, thus requiring extensive and expensive additions to the system. A serious problem has been and will be the annexation of lands to the city before water is provided. Extensive annexation can also create local overloads to the water system.

b. Ranchester

The town has part of and is applying for the rest of an \$853,000 grant to upgrade the water and sewer systems. Until the water and sewage facilities are completed, Ranchester may have difficulty providing adequate service during growth periods.

c. Dayton

The town's water system is presently deficient. A \$150,000 Federal grant has been awarded to the town for upgrading of the water system. Until the system is constructed, Dayton will find it difficult to cope with additional growth.

d. Rural Sheridan County and Decker area

The growth outside the incorporated towns will require small, subdivision water systems, or individual wells.

3. Wastewater Treatment

a. Sheridan

The city's sewage treatment plant would come under increasing pressure as new people move in. Depending on the spatial distribution of the new growth, existing collection system overloads would worsen and/or new ones occur. As increasing volumes of waste flow into the plant, it would decline in efficiency of treatment even further. Until the discharge standards are enforced, probably little would be done. Implementation of Powder River Area-wide Planning Organization (PRAPO) recommendations for the system would cost around \$2.5 million.

b. Ranchester

Part of the \$150,000 grant would go to upgrading the sewage system. Until the new plant is operational, sewage treatment would be increasingly inefficient, releasing greater quantities of untreated sewage to the Tongue River.

c. Dayton

Any further growth in Dayton would increase the existing problems with the sewage treatment lagoon. The impact of the existing, major seepage problem is not known, and it is therefore impossible to indicate the impact of additional seepage. It can be safely said that an extremely serious health hazard may exist and would worsen with further growth.

d. Rural Sheridan and Big Horn Counties

The major potential impact of scattered rural development without strict controls is the possible contamination of water sources by improperly designed, installed or maintained septic systems.

4. Solid Waste

a. Sheridan

An increasing growth rate in the county would shorten the lifetime of the single landfill available. This would hasten the need for additional site(s). There will also be an increase in scattered dumping.

b. Big Horn County

The proposed solid waste management plan should adequately serve the Decker area. The intention to place containers in the Decker area

should reduce scattered dumping. Until the plan is effective, there would be more people disposing of trash at traditional and new dump sites.

5. Schools

If the Spring Creek mine is approved, impacts on the school system would come from four groups of people, the construction workers and the operating workers from Spring Creek, the workers from other development in the region, and the secondary, induced employees and their families.

The construction phase of Spring Creek would last about 2 years, with the work force peaking at 480 the second year. The Old West Regional Commission Construction Worker Profile found that on the average, slightly over 60 percent of the construction force were nonlocal. (Present address is different before beginning of the project. This apparently does not capture those moving to an area in anticipation of work). Of these, nearly 25 percent were single, slightly more than 25 percent were married with families not present and just under 50 percent were married with families present. The construction worker profile at Spring Creek is assumed to be similar. A total of 475 people are expected to come into the area as a result of the 480 jobs with the construction of the Spring Creek mine. Of the total influx of 475 people, approximately 123 would be school-age children and would attend the Sheridan County schools¹. These people would reside in the Sheridan area only until construction activities were completed. A total of 522 people are expected to come into the area as a result of the 253 miners employed for the Spring Creek mine. Of the total of 522 people, approximately 137 would be school age children and would attend the Sheridan County schools.

6. Health Facilities

a. Hospitals

The Sheridan County Hospital is currently crowded, overworked and inadequate to satisfy health demands placed on it. Substantial additions or replacement is needed. Any additional population will place more stress on the facility and reduce the adequacy and efficiency of service. There will most likely be little impact on any other hospital facility in the region.

b. Health personnel

Sheridan is well supplied with physicians and other health care personnel due to its role as a regional center. In order to maintain this role and to provide for local needs, additional people will probably be needed.

¹Estimation generated from Coal Town II model.

Any growth which may occur in Big Horn County would cause further problems since it is currently understaffed in terms of medical facilities.

c. Nursing

The existing and planned facilities are considered adequate for foreseeable needs.

7. Law Enforcement

Based on experience in towns with rapid growth rates, it is expected that crimes would increase. This would put a strain on the existing police personnel and facilities and would require more officers and equipment. The smaller towns and rural areas which are presently inadequately staffed and equipped would have the hardest time coping with the impact. Unless additional funding is made available, the level of protection can only decrease.

8. Fire Protection

The exact impacts on fire protection are impossible to identify without knowing how many people would live in a given area. However, it is generally assumed that if the Spring Creek mine is approved most of the increase in population would live in the city of Sheridan. It is probable that some of the people would settle in rural areas or on the fringes of existing towns. This would require additional protection in already poorly served areas. Wherever people settle, required fireflows would increase and required response times would decrease. Some areas, particularly Dayton and Ranchester would have increasing problems providing service at all, much less adequate service. The improvements to the Ranchester water system would only partially help the fireflow deficiencies.

Increasing expenditures would be necessary in order to maintain existing levels of service. It is probable that as areas develop, there would be a demand for improved levels of service which would require even more expenditures.

K. Land Use

1. Local Impacts

The major direct land-use impact of the proposed action would be the conversion of nearly 7 square miles of a largely natural rural landscape to an industrial (strip mine) complex. This would be significant because it entails major changes affecting all land uses and values including esthetics, recreation, agriculture, wildlife, and watershed. This would involve conflicts between many of the existing uses and mining. Secondary impacts would occur as lands in the area (most critically, agricultural land) are converted to urban uses.

The 4,420 acres within the permit area would be diverted from its present livestock grazing, wildlife, and watershed use to mine pits, mine facilities, and eventually to a reshaped and revegetated surface on the mined-over portion.

At the end of the 25-year life of the mine, the entire area is proposed to return to present kinds of uses.

All livestock were removed from the minesite in late 1977 to allow range recovery, resulting in approximately 795 animal unit months (AUM's) per year being unavailable to the local livestock economy for a minimum of 2 years. Should livestock be reintroduced in later years, carrying capacity may be substantially improved, but the area available would fluctuate as mining advances and the reclamation cycle begins.

Although 250 acres within the permit area has been cultivated in the past, no current cropland would be impacted by the proposal; however, the permit area contains 1,705 acres of soils in land use capability classes III and IV, which has the potential for cropping use under appropriate management. (See chapter II, Soils.) This potential would be unavailable through the period required for revegetation to native plants.

Building of the proposed Spring Creek rail spur and access road would cause the loss of about 250 acres of rangeland. In addition, the ranching operations crossed by these corridors would be inconvenienced to the extent that existing pasture units are fragmented. A portion of the rail spur might be retained beyond the life of the proposed mine if additional mines were located which could make use of the track. If a portion of the rail spur were removed after mining had ceased and the land was reclaimed to sustain vegetation again, 10 to 15 years might be necessary before vegetation suitable for grazing could be reestablished.

Exploration and development by oil and gas lease holders within the permit area could be delayed during the cycle of mining and replacement of overburden. Impacts on potential development of oil and gas from the construction of the mine access road or the transportation corridor should be negligible, since these rights-of-way are sufficiently narrow that they would provide no serious hindrance to testing or developing any particular oil or gas structure.

No residences, public roads, private rights-of-way, or special use permits exist to be impacted within the permit area.

Impacts related to esthetics, recreation, wildlife and watershed are addressed in those sections.

2. Regional Impacts

In the surrounding areas, including Sheridan, transitions in land use are taking place due to the influx of new population. Restrictive city zoning, inflated land prices, and community growth contribute to

the location of housing developments in less regulated areas. The greatest impact from this is the loss of fertile flood plains and croplands, resulting in a reduction in productivity of the agricultural sector (chapter III, Economics). Additional problems are created as counties and municipalities encounter fiscal problems and as service deficiencies develop (chapter III, Community Services).

Additional residential acreage would be required in Sheridan and nearby small communities (chapter III, Community Services). Some of the new workers would seek residences nearer the mine in rural trailer courts or on individual rural acreages. How this demand would be distributed is difficult to predict at this time because it depends not only upon individual worker's preference but also on separate decisions by local governments, private developers, and landowners in the area.

Using Sheridan Area Planning Agency (SAPA) figures for total housing units in Sheridan, an average estimated 0.16 acre is required per unit. Assuming Spring Creek employees and the resulting ancillary population would require 374 housing units built to Sheridan's average density, at least 60 acres of land would be converted to housing developments to support the Spring Creek mine. If residents settled in suburban or rural areas, the acreage needed would be greater. If all new units were developed on 0.25-acre lots, 94 acres would be used. If 0.5-acre lots were developed, 187 acres would be used.

The most probable locus of population growth resulting from coal development along this portion of the Montana-Wyoming border is Sheridan County. And because the city of Sheridan is the most developed, the largest proportion of the new population would be expected to reside there. However a number of conditions suggest that other communities, most notably Ranchester and Dayton, would bear a considerable share of the impact. These conditions include: the availability of housing in Sheridan, transportation linkages which facilitate access to Ranchester-Dayton, and the atmosphere of receptivity to growth in the various communities.

Based on extensions of current growth patterns, an approximate distribution of population within Sheridan County can be projected. If all of the population growth occurs in Sheridan County, each of the three incorporated municipalities would be assumed to receive the following proportions of the increment: Sheridan 50.6 percent, Ranchester 11.2 percent, Dayton 4.7 percent.¹

Commercial sites and other land uses of an urban character would increase in proportion to residential land development. The small community of Decker would experience significant residential and commercial impact from this project. As population increases in the surrounding area, more

¹This distribution would be entirely different if a new town is developed near the proposed Spring Creek mine.

land would be needed for telephone and electrical service rights-of-way, water and sewer service where concentrated growth occurs, upgrading of existing roads, and construction of new roads to residential properties.

Regional impacts on agricultural, recreational, and wildlife lands are treated under these headings in this chapter.

3. Cumulative Land Use Impacts

The 4,420 acres encompassed in the Spring Creek application would be added to the 10,105 acres contained in the three existing mines¹ in the vicinity (southern Big Horn County, Montana, and northern Sheridan County, Wyoming). An estimated additional 8,136 acres are expected to be added to this area total in the next few years.²

Some 9.6 miles of rail spur, covering about 228 acres, would be required for railroad access to the Spring Creek mine. At least another 20 miles of rail line on an estimated 485 acres would be needed to connect the other proposed new mines in the area to the Burlington Northern main rail line. Additional miles of access road, expansion of existing road, and proportionally greater acreages of residential, commercial, and public use lands would be needed as other area mines are developed. Spring Creek would contribute to pressures toward the creation of one or more new towns in the immediate vicinity.

Major land use changes associated with these mines would be felt over a period of 20-40 years, as each mine progresses through the cycle of development to exhaustion of the recoverable reserves.

Since rehabilitation measures would be implemented as mining progresses, the total number of acres disturbed during the life of these mines would not be converted to a different land use at one time, but would constitute a rotation in land use, spaced over the life of each mine.

The more permanent changes in land use would be provided by roads, railroads, powerlines, office and maintenance shop buildings, and the induced urban and residential development.

Rural areas not subject to stringent land-use controls and land-development regulations may be adversely impacted by scattered development, and thus would affect adjacent land values.

4. Impact on Planning

One of the important impacts of coal development on local governments and communities would be to influence expansion of planning programs.

¹Decker, Big Horn, and Ash Creek mines.

²North Extension of Decker, Shell Pearl, and Consolidation CX mines.

Sheridan County has recently reestablished a professionally staffed planning commission which has embarked on an accelerated program of planning and capital expansion to meet the challenge of growth and coal development in the region. A social and economic environmental impact statement is currently being prepared under contract for the county (Les Jayne, oral communication, 1979.)

L. TRANSPORTATION SYSTEMS

The major impact on the present transportation system due to mining at Spring Creek would be an increase in volume on existing transportation modes. This would result in increased accident rates, system deterioration, rising maintenance costs, and decreased efficiency if not mitigated.

Employment of construction workers and permanent mine employees at Spring Creek is expected to bring 374 new households into the area by 1981. Most families have one or more vehicles which would add to existing street and highway use, parking space demand, and demand for vehicle repair and services. These additional people would also increase the usage of air and bus service on the route through Sheridan, Billings, and Casper.

1. Highways

Traffic volume on highway FAS 314 would increase proportionately to construction and mining activities. Fluctuations would occur relative to the degree of overlap between mining and construction activities. Traffic is expected to be heavy when shift changes occur and would be particularly heavy if the shift changes were to occur at the same time as those of other mines in the area.

Highways I-90, Wyoming Secondary Route 338, U.S. 87, and U.S. 212 would also receive heavier traffic as a result of the mine. The impact of the increased traffic from the Spring Creek mine would be comparatively small. However, there could be a minor increase in the accident rate on these highways. (See chapter IX, letter 22, Wyoming State Highways.)

The increased highway use would also lead to accelerated deterioration, and thus a reduction in capacity, especially for FAS 314. Unless serious deterioration occurred due to increased use by heavy trucks, this route is unlikely to be improved before 1985. Accident rates would increase due to the increased volume; however, system deterioration would also increase public expenditures required for maintenance or reconstruction.

System efficiency would decrease as traffic delays occurred at grade crossings. These delays would become more important as both vehicle volume and the number of unit-trains per day increased. During the first year of production, 10 to 12 unit-trains per week would be crossing the highway. At full production, approximately 40 trains per week would block the highway crossing; an average of 5.5 minutes per train. This would impede traffic approximately 3 hours and 40 minutes per week.

Equipment malfunctions would probably cause occasional delays of as much as 30 minutes or more at the crossing (Montana Highway Department Public Hearing, December 1976). These delays would inconvenience local ranchers and other residents, mine workers, school buses, mail and other deliveries, and--perhaps most seriously--emergency vehicles to Sheridan. The potential for car-railroad accidents would increase.

2. Railroads

The major impact of the Spring Creek mine upon the railroad system would be to increase traffic by about 300 unit-train round trips during the first year of production, increasing to about 1,000 round trips per year at peak production. On the Decker spur, these increases would amount to 28 percent and 93 percent, respectively. Each loaded unit-train would represent a round trip; therefore, traffic passing any point along the route would be twice the number of loaded trains. This traffic would require additional coal cars, locomotives, personnel, and increased maintenance of equipment and rights-of-way. Destinations are not known at this time, but coal trains would join the Burlington Northern main line at WYarno, Wyoming.

3. Cumulative Transportation Impacts

When coal produced at Spring Creek would leave the mine spur, it would travel over tracks also serving other local and regional mines and other local and regional rail users. Spring Creek traffic would add to impacts from already existing, or soon to be initiated, traffic in the general area. Locally, Spring Creek traffic would be added to the traffic generated by the existing Decker mine and the expected increase from opening the Decker East and North extensions. The following table shows the estimated cumulative local traffic that would be generated by these mines at full production and approximate at-grade crossing delay times.

Impacts from grade-crossing delays and increased potential for accidents would be felt all along the route, from the mines to the coal destination. No specific statement can be made about the duration of these delays or the degree of hazard since these vary widely with each crossing.

The city of Gillette, Wyoming, provides an example of some of the more serious effects produced by the rapid growth of coal train traffic in the Northern Great Plains. Gillette is divided by the BN main line track, and most of the city's essential services are located on the south side of the track. The mayor reports that only one grade separated crossing exists in the city and the present level of rail traffic has caused significant access problems between the two parts. Additional problems include safety, noise, and dust. Trains serving the Spring Creek mine may be routed over these tracks and would add to the problems Gillette currently recognizes. (See chapter IX, letter 26, city of Gillette.)

TABLE III-6.--Unit-trains per week past crossing¹

Road Crossings	From Spring Creek mine	From East Decker mine	From North Extension mine	From West Decker mine	From all four mines	Time per week crossings would be blocked by trains ²
County road---	---	25.8	---	---	25.8	1 hr 22 min
Route FAS-----	38.4	---	8.8	38.4	85.6	7 hr 51 min
Wyoming Highway 336 near Wyarno-----	(³)	25.8	8.8	38.4	73.0+	6 hr 39 min

¹Includes loaded outgoing and empty returning trains.

²According to Burlington Northern observations, loaded trains would block crossings an average of about 7 minutes; empty trains would block crossings an average of about 4 minutes, for an average of 5.5 minutes each.

³Specific routing and destinations for Spring Creek coal is not known, although 50 percent of the expected production is committed for use in Pacific Power and Light Co. thermal electric plants.

Delays estimated in table III-6 were from observation of train movement near the loading or destination point. In open country a 7,000-foot-long train passing at maximum allowable speed (50 mph) would require just over 1.5 minutes to clear the crossing. Additional delay results from the necessity of halting traffic at a safe interval from the crossing before the train reaches the crossing and a short interval for traffic flow to resume after passage. Train speed through crossing are influenced by a variety of factors including grade, track conditions, proximity to scheduled stops, or speed restrictions imposed by towns and cities on the route.

M. RECREATION

The fencing and excavation of the proposed mine would result in a negligible impact on recreation, because most of the 4,400 acres of potential recreational use in the Spring Creek permit area are privately owned and not currently open to public access. Secondary impacts would be increased use of nearby public and private lands and existing recreation facilities by Spring Creek mine employees and their families. The significance of the increased use would be a probable decrease in the quality of recreational experience rather than a decrease in the available opportunity. This, however, would be difficult to quantify.

The impact of increased use of lands and recreational facilities would include additional maintenance costs for facilities and increased conflict between rural landowners and recreational users. Increased use of facilities would also create additional interaction between users along with increased litter and possible pollution problems at both developed facilities and properties adjacent to the site.

There would probably be an increase in hunting, poaching, and trespassing as a consequence of the increased population accompanying mining activities.

N. CULTURAL RESOURCES

Impacts to cultural resources would consist of losses of archeological and historical sites for scientific research, public education, and other values. Losses would result from destruction, disturbance or removal of cultural resources as a result of coal mining activities, unauthorized collecting, and vandalism.

Ninety-three known sites and an undetermined number of unknown sites would be disturbed. In the area to be mined, 53 sites would be destroyed, 40 sites in the peripheral areas may be destroyed or disturbed to an undetermined degree.

A beneficial impact of development would be the gain in knowledge derived as a result of the cultural resource investigations which otherwise may never occur except as a result of mining.

O. ESTHETICS

The greatest impact on esthetic qualities, for the duration of mining, would be the marked change from a rural to an industrial setting. Although most of the mining operations would not be visible from the main road (FAS 314), some of the mine facilities and railroad would be clearly visible. Dust arising from mine operations would probably be one of the most obvious visual impacts.

Odors from vehicle emissions and dust would partially replace natural odors, predominantly the smell of vegetation. Sounds related to mining activities--trucks and trains, drilling, blasting, and coal-handling devices--would pervade the formerly quiet rural area.

Following the period of mining, quiet would return to the Spring Creek minesite, and the visual signs of mining, the facilities, and the railroad would be largely, if not entirely, camouflaged by reclaimed vegetation.

Because the topography would not be reconstructed to its original state, there would be a permanent loss in the pleasing visual qualities related to a rolling, irregular landscape having rock outcrops and a scattered distribution of trees and shrubs.

CHAPTER IV

MITIGATING MEASURES

Measures that would be used to mitigate the adverse impacts of mining are (1) those proposed by the company as a part of the mining and reclamation plan (if the plan is approved, the measures are binding on the company); (2) those required to meet the standards required by various Federal and State laws and regulations, the principal agencies being outlined in table I-1; and (3) additional requirements or stipulations that could be imposed at the discretion of the Area Mining Supervisor, the Commissioner of the Montana Department of State Lands, or other Federal or State agencies which have permit authority (such requirements must be reasonable and noncapricious). The mitigating measures proposed by the company or required by various laws and regulations are discussed in chapter I of this statement.

Additional mitigations which could be imposed, at the discretion of permit-issuing agencies, would necessarily be based on need as indicated by the failure or anticipated failure of proposed and required mitigations. Failure of mitigations could be identified through required monitoring and observation during mandatory inspections by the Area Mining Supervisor, USGS; staff personnel, Office of Surface Mining; the District Manager, BLM; Reclamation Division, Montana Department of State Lands; and other responsible State and Federal agencies.

Further measures and standards that could be imposed are discussed as alternatives in chapter VIII.

CHAPTER V

ADVERSE IMPACTS THAT CANNOT BE AVOIDED IF THE PROPOSALS ARE IMPLEMENTED

Mining would decrease the stability on about 4,420 acres of reclaimed land surface, thus resulting in increased erosion and deposition in the permit area, locally as much as 5 times the present levels. Severe gullying could occur upstream from and on the regraded highwalls along the southern part of the permit area (beginning in about the 20th year of mining), with consequent deposition at the foot of the regraded highwall; about 700 acres would be thus affected. Eroded sediment would not be expected to reach through-flowing streams. Erosion would increase slightly in Spring Creek downstream from the permit area because of a reduced sediment load of the stream exiting the permit area. Both during and after mining, runoff and sediment yield from the permit area would be slightly reduced, although sediment yield would be greatly increased during a 50-year flood during mining. There is a 40-percent probability that such a flood would occur during the 25-year life of the mine. The perennial reach of South Fork, in the southeast corner of the permit area, would be eliminated unless declared to be an alluvial valley under the definition of OSM, in which case, regulations could preclude disturbance. Several ephemeral impoundments would be removed from the permit area. Although magnesium sulfate leached from the spoils would slightly reduce ground-water quality in the Anderson-Dietz aquifer east of the permit area, that reduction would probably not conflict with anticipated uses of ground water. The water level in one well (NE1/4NE1/4 sec. 31, T. 8 S., R. 40 E.) would be lowered, possibly enough to make the well unusable.

Air quality would be degraded by particulates (dust) and emissions of pollutant gases continuing through the life of the mine. It is anticipated that the maximum allowable Montana guidelines and Federal primary standards for 24-hour concentrations of total suspended particulates (TSP) would be exceeded several times a year. Fugitive dust, theoretically amounting to as much as 21,000 tons per year, would adversely affect the growth of vegetation, as well as animals that would feed on that vegetation.

Soils would be altered within the permit area and their productivity would be slightly reduced on about 2,200 acres (including facilities location and associated disturbances) and moderately reduced on about 2,000 acres actually mined. The replaced soils would become increasingly sodic, especially in the eastern half of the permit area. That impact would be severe for about a century. The sodic condition of the soil would further increase the instability of the land surface. A combination of sodic and saline spoils would impede reclamation unless intensive management were undertaken. Saline soils would further impede seed germination rates and seedling establishment on reclaimed areas. Vegetative productivity would thus be slightly to moderately reduced for several decades, especially on the sodic soils in the eastern half of the permit area and on the aggrading footslopes of the regraded highwall. The vegetative mosaic and species diversity would be eliminated, probably for about a century, although new mosaic would begin to develop within about 10 to 20 years. Adequate ground

cover would probably develop within about 10 years, but it would be more susceptible to drought than native vegetation. Ponderosa pines would probably not reproduce on the disturbed areas; junipers would probably reestablish after about 25 years; and riparian vegetation would not grow along the perennial reach of South Fork if it were disturbed. (See discussion above.)

The carrying capacity of the permit area would be reduced for all wildlife and greatly reduced for certain species. The carrying capacity of winter range would be lowered and possibly would affect animals for a distance of as much as 25 to 30 miles. Small animals would be almost totally eliminated from disturbed areas during mining and would not approach premining populations for at least several decades after disturbance. Rabbit populations would probably not reattain premining levels. Sage grouse populations would be severely reduced on and around the permit area, and sharp-tailed grouse populations also would be reduced. Populations of raptorial birds (great-horned owls, kestrels, long-eared owls, and red-tailed hawks) would be displaced from the minesite, although the impacts to these species would be of minor importance within the subregion.

The Spring Creek mine would contribute about 4 percent to the population growth of Sheridan County between 1978 and 1990, negligibly to the population growth of Big Horn County. Thus the mine would significantly contribute to impacts already being felt in Sheridan County and generally contribute to the cumulative impacts of all mining and related activity.

The majority of the fiscal impacts would fall upon Sheridan County and city. Nearly all revenues generated by mining activities at Spring Creek (coal severance tax, property tax, and personal income tax) would go to Montana and Big Horn County. There would be small differences in contributions to Wyoming State revenue (sales tax, property tax, and license fees) associated with the Spring Creek mine. Until available State and Federal grant money is fully utilized by Sheridan County and city, community services would be short of funds to meet demands from the added population due to Spring Creek. Individuals working in the local service sector, and people on fixed incomes, the elderly and the poor, would be most severely affected by economic stimulation and inflation resulting from growth due to Spring Creek. Spring Creek would contribute about 300 students to Sheridan County school districts by the year 1990.

About 7 square miles of land used dominantly for grazing and wildlife habitat would be used, instead, for coal mining and related support facilities for about 25 years. After reclamation, disturbed lands could not, according to the law, be used for agriculture (even if suitable) until native vegetation had first been reestablished and bonding requirements met. About 60 acres of agricultural lands, dominantly in Sheridan County, would be permanently urbanized in response to population growth caused partly by several hundred employees of the Spring Creek mine.

Traffic would increase moderately on FAS 314 between the mine and Sheridan. Regionally, traffic would increase slightly on I-90, U.S. 87, U.S. 212, and Wyoming 338. Increased rail traffic would hamper local

traffic at the existing at-grade crossing south of the West Decker mine. At full production, the Spring Creek mine would account for almost half of the 86 trains per week on the rail spur to the Burlington Northern line at Wyarno. Each train would delay traffic about 5 minutes, although malfunctions would commonly delay traffic for 30 minutes or more.

The perceived quality of recreation would decline, although actual recreation opportunities would probably still be adequate. Dominant impacts would be to outdoor recreation facilities on the Tongue River Reservoir, in Big Horn and Custer National Forests, and to urban recreation facilities in Sheridan and Sheridan County.

Ninety-three known archeological sites (16 of which have been determined eligible for inclusion in the National Register of Historic Places) and an undetermined number of unknown sites would be disturbed. In the area to be mined, 53 sites would be destroyed. Forty sites in the peripheral areas may be destroyed or disturbed to an undetermined degree. Unavoidable destruction, disturbance, and removal of paleontological resources, both exposed and unexposed, would occur.

CHAPTER VI

THE RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF MAN'S ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

Surface coal mining is not a new industry in southeastern Big Horn County, Montana, and Sheridan County, Wyoming. The present rate of coal production in the area is approximately 12 million tons per year. The Spring Creek mine would nearly double the amount of coal being exported; however, the percentage related to Spring Creek would decline as the East Decker mine expands and as other new mines may become established. Within this subregion, it is estimated that there are approximately 10 billion tons of strippable coal reserves (Matson and Blumer, 1973; Lageson and others, 1978). Depending on a continuing market demand for low-sulfur subbituminous coal, it is anticipated that the coal industry will continue to grow. Given the reserves that are estimated, mining could conceivably continue within the local area for a century assuming a production rate of 100 million tons per year.

The proposed short-term use of the Spring Creek permit area is the mining of 243 million tons of coal from an area of about 1,850 acres within a mine permit area of 4,420 acres. Short-term environmental impacts would be important in the area of social and economic conditions, because of rapid population growth and economic stimulus related to the Spring Creek mine. These impacts resulting directly from Spring Creek would become relatively less severe after the first several years because of assimilation of the new population and because of further growth in the area associated with other projects.

During mining, air quality would be reduced and would probably violate standards about 5 times per year for total suspended particulates (TSP). Land use would change from grazing and wildlife habitat, as soils were progressively disturbed and vegetation removed, ultimately on nearly all of the 4,420-acre permit area.

Long-term environmental costs of mining coal at Spring Creek, by methods proposed in the original company plan, would be caused primarily by the physical disruption of the presently balanced ecosystem--the soils, the vegetation, and the hydrologic regime.

Within a few decades to about a century after abandonment of the mine, the soils and vegetation would probably support essentially the premining land uses at about 80-90 percent of the premining level. The loss of vegetative diversity and vegetation mosaic would be among the impacts of longest duration, with concomitant lag in the development of specialized wildlife habitat, especially for sage grouse.

Introduction of a major change in topography of the reclaimed mine area would cause a disequilibrium in the geomorphic stability of the area. Removal of the alluvium of South Fork would cause permanent destruction of the only spring that now exists within the permit area. Ground water within the replaced overburden and the Anderson-Dietz aquifer would be permanently reduced in quality.

Archeological and historical sites and artifacts are nonrenewable resources. In the event that significant sites are not located during the survey process and are destroyed during mining, the resource loss would be irretrievable. In addition to the possible loss of such a physical resource, educational and scientific information regarding our cultural heritage would also be lost to both present and future generations.

CHAPTER VII

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

During the 25-year life of the proposed mine, 243 million tons of coal would be removed and utilized for power generation. Mining activities would consume 2.25 million gallons of diesel fuel, 32,000 gallons of gasoline, 50 million kilowatt hours of electricity (assuming two 8-hour shifts, 5 days per week), and 184 acre-feet of ground/surface water (which could not be used until it returns to the hydrologic system) annually. About 1-2 million tons of coal would be dispersed in the replaced spoils and, thus, would not be available for future recovery. The Canyon coal bed would not be recovered, although anticipated advancements in mining technology would make the bed recoverable in the future. An intermediate amount of clinker and a small amount of gravel would be lost to future use as construction materials within the immediate area. Additional commitment of resources would include both capital expenditures (on mining equipment) and human resources (time and labor). The hydrologic integrity of the Anderson-Dietz aquifer, the alluvial aquifer, and the surface water systems within the mine area would be destroyed and lost to future use. Topographic relief would be irreversibly altered, thus creating a single airshed where two had previously existed. Stream channels flowing over the highwalls would irreversibly alter the erosion and deposition characteristics of the area.

The productive capacity of the soils would be lowered through the disruption of the soils' physical, chemical, and biological characteristics. Alteration of this productive capacity would reduce the vegetative productivity and diversity and would eliminate ponderosa pines and much of the riparian community species as self-sustaining populations. In response to the alteration of vegetative productivity and diversity, the carrying capacity for wildlife would be accordingly reduced, principally for antelope, mule deer, sage grouse and raptors (through a loss of preferential nesting areas).

Social and economic environments may be transformed, although historically areas once developed in association with deep mining in the Sheridan area have reverted to agricultural lands. Suburbanization and commercial development of some lands adjacent to the population centers would be committed and would constitute irreversible land uses.

The necessary mitigatory measures, as deemed appropriate by the Advisory Council on Historic Preservation, would be implementd at the the 16 archeological sites that have been nominated for inclusion on the National Register of Historic Places prior to disturbance; however, additional undiscovered sites of comparable significance may be hidden beneath the surface and could be destroyed by mining.

CHAPTER VIII

ALTERNATIVES TO THE PROPOSED ACTIONS

Approval of the Spring Creek mine and reclamation plan must be made by both the Secretary of the Interior and the Commissioner of the Montana Department of State Lands. Various alternatives to direct approval of the proposed mine can be initiated by either the Secretary or the Commissioner when it is deemed necessary to minimize impacts of the proposed mining; however, modifications to the mining and reclamation plan must be approved by both the Secretary and the Commissioner. Because of differences between Federal and State regulatory and approving authorities, courses of action and alternatives imposed may be significantly different. The alternatives that apply to the Spring Creek mining proposal include those resulting from the administration of existing regulations of the Federal and State regulatory agencies. The options available to these agencies, as provided by existing legislation, and the resulting impacts of exercising these options are discussed below, as well as technological alternatives to the proposed operation.

A large part of this chapter is devoted to the description and analysis of an amended mine and reclamation plan, termed the "Central Field mine plan," which was submitted by the company in response to letters from the Department of State Lands noting deficiencies in the original plan. This alternative is discussed in section E. Because the Central Field mine plan was prepared in order to mitigate many of the environmental problems associated with the original plan, the original plan has become, in fact, an alternative to the amended plan.

In terms of the options that are available to Federal and State decisionmakers, the administrative alternatives described below are applicable to the amended plan as well as to the original plan.

A. ADMINISTRATIVE ALTERNATIVES AVAILABLE TO THE SECRETARY OF THE INTERIOR IN RELATION TO THE PROPOSED FEDERAL ACTION IN THIS STATEMENT¹

1. No Action

Pursuant to implied covenants of both the Federal mineral leasing laws and the existing lease agreements, the Secretary of the Interior must respond to a legitimate application to conduct operations on a valid Federal lease, provided all terms and conditions of the lease have been met. The Secretary's response may be approval as proposed, rejection on various legitimate grounds, or deferral of

¹The descriptions of administrative alternatives in this final environmental statement have been modified to some extent from the DES to reflect the most recent definitions of existing legislation and implementing regulations. Changes in this section, therefore, will not be underlined.

the decision based on proper grounds. "No action" on the applicant's proposed mining and reclamation plan would mean maintaining the status quo on the leasehold. The impacts of taking no action would be the same as described subsequently under the alternative "Reject the Mining and Reclamation Plan."

2. Defer Federal Action

In the event of noncompliance of the applicant's proposed mining and reclamation plan to provisions of the Surface Mining Control and Reclamation Act of 1977 (30 USC 1201), the Secretary must defer action on the proposed plan. For other proper causes, he may also defer the decision. Such causes could include, but are not limited to, the time required and the need for the following:

- . Modification of the proposal to correct deficiencies unrelated to SMCRA or to reduce or avoid environmental impact.
- . Acquisition of additional data to provide an improved basis for technical or environmental evaluation.
- . Further evaluation of the proposal and/or alternatives.
- . Development of an adequate system to monitor impacts for management and regulation.

The principal effect of deferring action would be a short-term delay in the imposition of all related impacts, both adverse and beneficial, of the applicant's proposal discussed in this statement.

The mining and reclamation plan included in this statement was prepared prior to the promulgation of the initial regulations (30 CFR 700) required under section 502 of the Surface Mining Control and Reclamation Act of 1977 (SMCRA).

The Office of Surface Mining (OSM), which was created by that act, has not reviewed the original plan for compliance. Therefore, that mining and reclamation plan may not reflect the requirements of the initial regulations. However, in this statement the applicable initial regulations are considered as a required Federal mitigating measure and are included in chapter I, part D.

The original mining and reclamation plan was returned to the operator by the Montana Department of State Lands with a request that it be revised in accordance with the applicable regulations. In response to that request, the company submitted a preliminary modification of the mine plan in April 1978, which was addressed in chapter VIII of the draft environmental statement (DES 78-30). A formal submittal of the amended Central Field mine plan was made to the Montana Department of State Lands and to OSM on August 11, 1978, and final modifications were submitted in January 1979. This amended plan is addressed in section E of this chapter. It will be evaluated by appropriate regulatory agencies to determine

compliance with the requirements of 30 CFR 700 et seq. and other applicable State and Federal law. Action could be deferred until the plan is further modified to bring it into full compliance with all regulations.

3. Prevent Development of the Lease

a. Reject the Spring Creek mining and reclamation plan

The Secretary may reject a proposed plan that does not meet the prescriptions of applicable law and regulations under his authority, including the potential for environmental impact that could be reduced or avoided by adoption of a significantly different course of action by the applicant. Except when a mine plan does not comply with existing regulations, the Secretary cannot under present circumstances reject the proposed plans to the extent that a de facto cancellation of a lease results unless he seeks and obtains additional authority from the Congress. Viability of this option is dependent upon timely legislative action; the option of rejecting the proposed plans pending legislation remains available.

If the Secretary were to reject the mining and reclamation plan, the lease would not be mined, and impacts previously discussed would be deferred and potentially reduced or eliminated, dependent on the acceptance of a new proposal. The lease would continue in its present condition, subject to modification by natural processes and by the continuation of other existing activity and uses--and to further modification by the surface owner to meet other uses. However, the development of alternative sources of energy, such as other coal mines in the county, or a reduction of national energy consumption, could result. The applicant could correct the deficiencies in the plan and resubmit a modified mining and reclamation plan for approval. The result would be similar to that described in the alternative "Defer Federal Action."

b. Seek legislation to cancel the lease

The Secretary has very limited authority with respect to cancellation of an existing Federal coal lease. One such authority is prescribed in the lease terms entitled "Proceedings in Case of Default."

A second authority was mandated by provisions of section 6 of the Federal Coal Leasing Amendments Act of 1975 (P.L. 94-377) which was subsequently written into regulations as 43 CFR 3500.5. The authority relates to failure of the lessee to meet the requirements for diligent development of the lease as defined by the act.

The Authority to cancel on other grounds would require congressional authorization for such action as well as for the requisite funds for compensation to the lessee. The Administration has not requested such legislation, and the Congress has not initiated such legislation related to the matters considered in this statement. The possibility of such

actions is a matter for further consideration by the Administration and the Congress in the light of this environmental statement and other relevant nonenvironmental concerns.

To the extent that future coal production from this lease was curtailed or halted, alternative sources of energy would be required to meet anticipated needs and demands. The time required to replace the coal production potential could range from a few to several years. If this lease were cancelled through congressional authorization, all physical, biologic, and socioeconomic impacts stemming from the proposed mine would be avoided. Conversely, if development eventually were authorized, environmental impacts as discussed in chapter III or chapter VIII-E of this statement would occur, although impacts would be deferred in time and perhaps reduced because of changes in technology or requirements imposed at that time.

c. Exchange the existing lease

If the Secretary determines it to be in the public interest, he may initiate a proposal to the lessee for exchange of the existing Federal lease involved in this proposal for lease of other tracts of Federal coal or tracts of Federal sodium, phosphate, potash, or sulfur of comparable value, or for a grant of various future rights.

The Department of the Interior considers that the public interest would be so served if the Secretary finds that the benefits of production from the lease would not outweigh the adverse effects, or threat of damage or destruction to agricultural production potential, or scenic, biological, geologic, historic, or other public interest values from lease operations. In exercising his discretion to exchange mineral leasing values in the public interest, the Secretary shall consider, but is not limited to, consideration of these elements of the public interest: recreational use; archeological or historic values; threatened or endangered species; proximity of residential or urban areas; study for potential inclusion in the wilderness or wild and scenic rivers systems; and value for public highways, airports, and rights-of-way.

Should the Secretary initiate such a proposal, the lessee is under no obligation to enter into such negotiations and may refuse to consider it.

If such a proposal is made and is rejected by the lessee, or if negotiations are entered and not agreeably concluded by the parties, and if the operations described in this statement are not otherwise prevented, such operations would eventually proceed and result in the impacts identified herein.

If an exchange proposal is made, accepted, and agreeably concluded for coal that is contiguous to or very near the existing lease, the proposed plan would have to be revised, resubmitted, and assessed. If the new plan encompassed the same methodology to be used in coal development, many of the impacts described herein would likely be very

similar to those resulting from the new proposal, with a relatively short-term delay (several years) in their initiation. If a wholly different methodology is proposed for development of the replacement lease (e.g., underground versus surface mining), it could be substantially different from those described in this statement, and cannot be forecast at this time.

Presumably the unacceptable impacts or effects prompting the exchange would be avoided or substantially reduced, in development of the replacement lease, and found to be in the public interest. The existing lease would be relinquished, would not be mined, and would continue in its present condition.

If an agreeable exchange were made for coal located elsewhere, or for a different mineral commodity located elsewhere, the relinquished lease would continue in its present condition, subject to modification by natural processes, by the continuation of other existing uses and activity, and to further modification by the surface owner to meet other uses. Potentially, the coal reserves relinquished would be withdrawn from development and this source of energy foregone. Direct financial benefits to the public may change in an exchange of leases.

The impact of exploration and development of the replacement lease under these circumstances will be translocated in space and time. They will relate to time and location, physical environment at the new site, mineral commodity involved, development technology proposed and approved, and other factors, none of which can be quantified or evaluated until the replacement lease is identified. The environmental impact of potential development of the replacement lease rights to be granted would be evaluated and considered in the exchange process, and while they may be greater or less than those described in this statement, they must be ultimately judged by the Secretary to be more environmentally acceptable than development of the relinquished lease, and to be in the public interest. Costs to the Department in identifying and evaluating one or more replacement tracts to be offered in the exchange could be substantial, and very likely be significantly more than the lessee's costs in establishing the fair market value of the tract to be relinquished.

d. Suspend operations

Full development of the existing lease could be delayed by suspension of operations. If such action were taken, there would be no additional incremental environmental impact on the area, and it would continue in its present condition, subject to further modification by natural processes, the continuation of existing mining activity, and such future uses of the surface as the owners may decide.

The authority of the Secretary of the Interior to suspend operations on existing leases has already been utilized on other Federal leases. Suspension of operations of this existing lease, for reasonable periods, with proper grounds, could be imposed. The Secretary cannot, under present circumstances, suspend operations to the extent that a de facto cancel-

lation of a lease results unless he seeks and obtains additional authority from Congress. Viability of this option is dependent upon timely legislative action; the option of suspending operations pending legislation remains available. Impacts of this alternative would be similar to those described under "Cancel the Lease."

e. Federal reacquisition of leased rights

The outstanding leasehold interests could be acquired by the Secretary. The ability to acquire the leasehold interests is not granted by the existing relevant statutes and would require Congressional authorization for such action as well as for the requisite funds for compensation of the lessees. To date, the Administration has not requested such action, and the Congress has not initiated or considered such legislation; the possibility thereof is thus conjectural at best. The major effects of such Congressional authorization would be similar to those of cancellation of the lease as previously discussed.

4. Restrict Development on the Lease

The subject lease conveys the right to develop, produce, and market the Federal coal resource thereon if all other terms and conditions have been met by the lessee. In general, the Secretary does not possess the authority to arbitrarily restrict development either as to location or rate. Various measures that may tend to restrict development may be taken by the Secretary at any time in the interest of conservation of resources or in the protection of various specific environmental values in accordance with existing laws and regulations; for example, the National Historic Preservation Act of 1966, the Endangered Species Act of 1973, etc.

Thus, under present conditions, a general effort to restrict or regulate development of the existing lease for reasons other than failure to comply with existing laws and regulations would constitute a selective application of the "prevent development" alternative already discussed; that decision, as it related to impacts, possible litigation, and the need for authorizing legislation, would be relevant in this instance.

In addition, application of this alternative might not permit maximum recovery of the coal resources and would thus be contrary to principles of conservation embodied in the legislation which authorizes the leasing of these lands for the purposes described. It is entirely possible that such selective mining would leave isolated blocks of coal that might never be recovered owing to the high costs of mining such remnant areas at a later date.

5. Require Modification of the Plan to Improve It Technically and Reduce Anticipated Impacts of the Operation

A number of the impacts identified and described in chapter III of this statement could be more fully mitigated by the selective application of those measures described that are supplemental to the

proposal of the Spring Creek Coal Company or by implementation of one or more of the technical alternatives described more fully in part C below. Among the more obvious options to be considered are the kinds of technical modifications that may be covered by requirements of the Surface Mining Control and Reclamation Act when fully implemented as 30 CFR 700 et seq. Examples of these would be:

- . Change in the configuration of the proposed mine area in order to avoid sites or features of special environmental value, such as alluvial valley floors.
- . Modification of dust control technology at the minesite and loadout facilities, and the control of dust loss from unit-trains.
- . Modification of proposed postmining topography.
- . Modification of proposed reclamation practices applied to overburden, topsoil, revegetation, and protection of the reclaimed surface.
- . Modification of proposed wildlife management practices.

Such modifications could include any that might be imposed by the State of Montana in its approval process. Under the joint agreement (30 CFR 211), the State advises the Secretary of its decision, and the Secretary subsequently renders his decision on the State-approved plan (See chapter VIII, Administrative alternatives available to the Montana Department of State Lands.) In addition, special conditions could be added to the approved plans in relation to the secondary effects of mining. Such conditions must be reasonable and, if unacceptable to the lessee, could result in the lessee not developing the lease areas with the resultant impacts previously discussed in chapter VIII under the subsection entitled, "Reject the Mining and Reclamation Plan."

6. Allow Development of Selected Areas Now Under Lease

This alternative would permit only selective exploration and development of the existing leasehold, based on anticipated adverse environmental consequences. The decisionmaker has the authority and responsibility to evaluate the coal resources and impacts of mining on this lease prior to acting on the proposal. Exploration and development could be allowed only on the leasehold, or portions thereof, that would have the lowest anticipated adverse environmental consequences. Weighing the tradeoffs of mining or precluding mining on selected tracts is part of the evaluation and decision process. Adoption of this alternative would reduce adverse effects by reducing the area in which the impacting activities could take place.

The alternative of allowing the development of only selected areas already under lease constitutes a selective application of the alternative of preventing further development of the existing lease described above. Without a showing lease-by-lease or plan-by-plan of the like-

likelihood of wholly unacceptable environmental impacts that could not be reduced to an acceptable level, the Secretary does not possess the authority to otherwise constrain development of the leasehold if all other requirements of the lease have been met. In addition, application of this alternative would be contrary to principles of conservation embodied in the legislation which authorizes the leasing of these lands for the purposes described. It is entirely possible that such selective mining would leave isolated blocks of coal that might never be recovered owing to the high costs of mining such remnant areas at a later date.

B. ADMINISTRATIVE ALTERNATIVES AVAILABLE TO STATE AGENCIES

1. Department of State Lands

The authority for State action regarding mining and reclamation rests with three laws:

- (1) Montana Strip and Underground Mine Reclamation Act
- (2) Montana Strip Mine Siting Act
- (3) Montana Strip-Mined Coal Conservation Act

The State does not have an equivalent to the Federal "no action" alternative. If, in fact, no action were taken by the Department within 240 days after receipt of a complete application for a mining and reclamation permit, the permit would be statutorily approved, by default.

The State also does not have a formal administrative alternative to "defer action" following the receipt of a completed application for a mine and reclamation permit. However, the State may deem an application incomplete due to failure of the mine and reclamation plan to meet State requirements, leading to a postponement of the action, which has the effect of deferral.

Other than the decisions to approve or disapprove a permit, only two viable alternatives are open to the State: (1) approval of the permit with modification; and (2) selective denial of the permit to mine in a specified area that includes lands having special, exceptional, critical, or unique characteristics, or where mining would affect the use, enjoyment, or fundamental character of neighboring land having the above special characteristics. Either or both of these alternatives, which could be legally invoked after the permit application was deemed complete, would generally be exercised by the Department during its review of the application, thereby making modification and/or selective denial prerequisite to the acceptance of a completed application.

Impacts that would result from rejection of the Spring Creek permit application would be the same as those discussed under the Federal administrative alternative of preventing development of the existing

lease. Impacts that would result from approval of the original mine and reclamation plan are those analyzed in chapter III. Impacts that would result from modification of the permit application, of which the amended Central Field mine plan is an example, or from selective denial of the permit to mine in certain areas, are similar to those discussed under Administrative Alternatives available to the Secretary of the Interior and under part E of this chapter.

2. Department of Health and Environmental Sciences

The Montana Clean Air Act is the law under which the Department of Health and Environmental Sciences would exercise its authority to take action on the application for a permit to construct and operate coal-handling facilities at Spring Creek. Such action would pertain to the designs for constructing coal-crushing, storage, and loadout structures, and to the operation of coal-handling facilities after construction, in order to insure that the best possible control technology would be applied toward preventing and abating air pollution.

Three administrative alternatives open to the Department are disapproval, approval, or approval after acceptable modification of the construction and/or operating designs.

Decisions of the Department of Health and Environmental Sciences are not contingent on those of the Department of State Lands, with the result that disapproval by either Agency would cause rejection of the entire project. The impacts due to disapproval of the permit for coal-handling facilities would therefore be the same as those from rejection of the mine and reclamation permit. Impacts due to approval of the coal-handling facilities are those analyzed in chapter III. Impacts that would result from modification of the designs for construction and/or operation of coal-handling facilities are discussed under Technical Alternatives.

3. Department of Natural Resources and Conservation

Under the Montana Act, the Montana Department of Natural Resources and Conservation has authority to take action on the permit application for the railroad access corridor to Spring Creek. For other permitting responsibilities by the State and Federal agencies. (See table I-1.)

C. TECHNICAL ALTERNATIVES

Alternatives to the proposed mine and reclamation plan that would entail different configurations of the mine area, different procedures for mining or reclamation, different rates of production, or different coal transportation systems are considered to be technical in nature. These alternatives would affect the construction and operation of the

proposed Spring Creek mine, and the various alternatives could produce different environmental impacts.

1. Configuration of the Proposed Mine Area

The mine area proposed under the original plan was selected to obtain the maximum recovery of a nonrenewable fuel resource consistent with reclamation of the land and protection of other resources. Restriction of the size or shape of the area to be mined, within the lease boundary, would be expected to reduce the adverse environmental impacts in the presently proposed area.

The amount of reduction in the number of acres to be mined within the permit boundary would be limited for both economic and environmental reasons. Economically, each acre of coal left unmined would represent approximately 142,000 tons (assuming a thickness of 81 feet and a bulk density of about 1,750 tons per acre-foot). The valleys of both Spring Creek and South Fork Spring Creek are economically most attractive for mining because the overburden is thinnest there; however, if 81 feet of coal were removed from only beneath the valleys there would not be enough spoils to fill the pits: to leave depressions after mining would be unacceptable. The company proposes to use overburden, obtained from the ridge between Spring Creek and South Fork, to fill the void left by removal of the coal.

2. Mining Procedures

Different procedures could be required for removing topsoil overburden, and coal if the procedures as proposed were considered technically inadequate, unsafe, or likely to result in unacceptable environmental consequences. The methods proposed in both the original and the amended mining plans are those currently in use at other existing mines in southeastern Montana, Wyoming, and at other large strip mines in the West and are generally accepted as being the safest, the least wasteful, and the most technically and economically feasible for this type of operation.

It is difficult to envision any reasonable alternatives to the company's proposal to mine by dragline in combination with trucks and shovels, unless it would be to omit the dragline and use only trucks and shovels. Environmental impacts that would result from using trucks and shovels only would be expected to differ very little from those that would result from the proposal outlined in chapter I and analyzed in chapter III. Additional impacts would result, however, from the increased number of trucks and shovels required; the increased traffic on haul roads, for which dust suppression would be required; an increase in the number of employees to operate equipment; and an increase in the amount of water required for mine and plant use.

One advantage of using trucks and shovels would be the capability to mine deeper than would be feasible with the dragline, enabling possible

recovery of the Canyon Coal seam, 106 feet below the Anderson-Dietz. The 19-foot-thick Canyon seam would add approximately 55 million tons to the recoverable reserves within the lease area.

Underground mining is not considered a viable alternative inasmuch it is not economically competitive, it is wasteful and dangerous and the long-term prospect of subsidence of the land surface is not acceptable.

3. Coal Production Rates

Under terms of the lease and existing regulations, the Secretary of Interior lacks the authority to regulate production, per se, from the leasehold. However, some degree of control over production rates could be effected on environmental or other adequate grounds.

The original mining plan calls for a production rate of 10 million tons per year by 1982. A lower mining rate would result in less land being disturbed at any one time and thus a lesser environmental impact each year. However, to produce the same total amount of coal from the lease, the duration of impact would be extended. Less production would also mean reduced employment and annual royalty income to the U. S. Treasury and the State and less tax revenue to Federal, State, and local governments.

Increasing the rate of production would result in an accelerated rate of land disturbance, higher employment levels, additional vehicle and rail traffic in the area, and an acceleration in the rate of environmental impacts previously discussed. There would also be larger annual royalty payments to the Federal Treasury and the State, higher payrolls, and increased tax revenues if production were increased. The total duration of impacts would be shortened accordingly.

4. Coal Transportation System

If the U.S. Congress grants to pipeline companies the right of eminent domain for acquiring rights-of-way for pipelines, slurry pipeline may become a viable and competitive alternative to rail transportation of coal to market.

To date, several slurry pipelines have been used successfully to transport crushed coal, iron ore, and other minerals over appreciable distances. An example is the 275-mile-long Peabody Coal Company pipeline in Arizona. Slurry pipelines, like pipelines used for transporting oil and gas, are underground and, except for pumping and storage facilities are not visible at the surface. Dust, noise, and traffic danger resulting from the transportation of an equivalent amount of coal by rail transportation, thereby would be eliminated. Assuming that equal weights of water and coal are mixed in a slurry, approximately 700 acre-feet of water is required per million tons of coal transported, or an equivalent of about 10 cubic feet per second at a production rate of 10 million tons per year when the mine reaches full production. Although this amount of water could feasibly be developed from local or imported sources, the

use of water for slurry transportation would involve numerous political, legal, and public decisions requiring a lengthy period for resolution.

D. TECHNICAL ALTERNATIVES PROPOSED BY THE COMPANY

1. Highwall Reduction

In response to the January 12, 1978 letter from the Montana Department of State Lands to the company outlining deficiencies in the original mine plan, the company presented a preliminary alternative plan for reducing highwalls along the original mine plan's southern boundary. The plan proposes to reduce the highwalls by backfilling them with overburden materials "borrowed" from an area east of and adjacent to the mining area as opposed to backcutting into the steep, undisturbed terrain south of the mining area. This plan consists of three versions (cases). In each case, presented below, the location of the borrow area and the extent of the disturbance are the same. Although in none of the cases is all the available material in the 508-acre "borrow" area used, the size of the "borrow" area was determined on the basis of the maximum amount of material needed to reduce all highwalls (i.e. southern and western).

Implementation of the backfilling plan would require an extension of the permit bonding area by about 2,000 feet to the east and upgrading the bonding from associated disturbance to mining-level disturbance. The reclaimed topography of the "borrow" area would create a continuation of the east-west trending plain between the channels of Spring Creek and South Fork.

a. Case 1 (fig. VIII-1)

This case assumes mining to the limits of the original mine plan. The highwall created along the southern boundary would be completely backfilled, starting at the crest and sloped into the contour of the reclaimed mining area at a 5:1 (20 percent) gradient. Although the proposed borrow area is 508 acres under Case 1, only 61 percent (310 acres) of the borrow area would have to be disturbed to obtain sufficient material to backfill the highwall. One hundred forty-five acres that would have been disturbed by backcutting of the highwall under the original plan would be left undisturbed in this case. Considering that 94 acres would have been disturbed by the scoria pit under the original plan, there would be a net increase of 71 acres in the total area to be disturbed in Case 1 (310 acres minus 145 acres minus 84 acres).

b. Case 2 (fig. VIII-2)

As with Case 1, Case 2 proposes mining to the limits of the original mine plan and backfilling the southern boundary highwall to a 5:1 slope. However, this case proposes to leave portions of the highwall intact for wildlife habitat and for esthetic reasons. Under this case, 50 percent

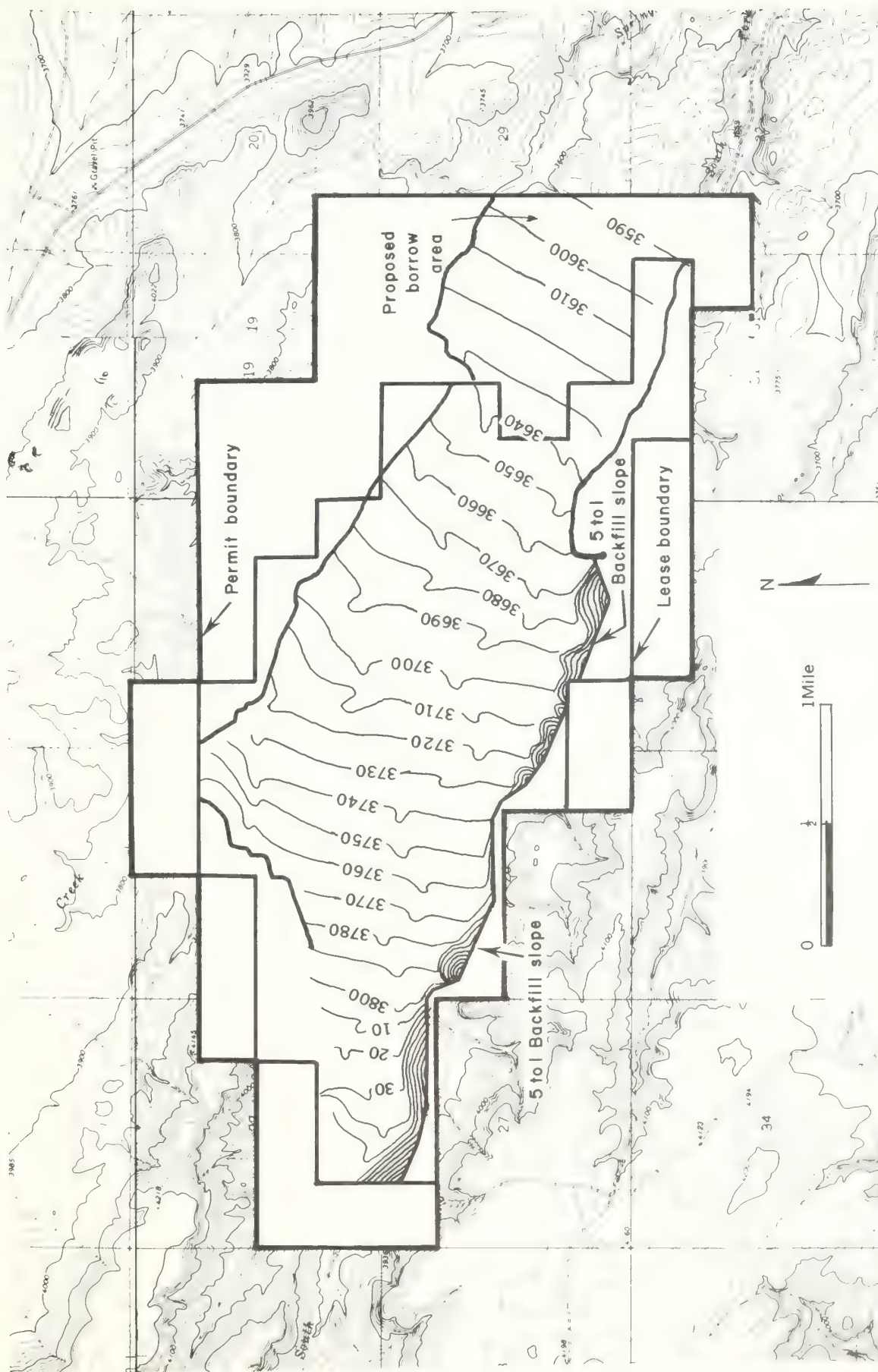


FIGURE VIII-1.--Case 1 - Highway reduction.

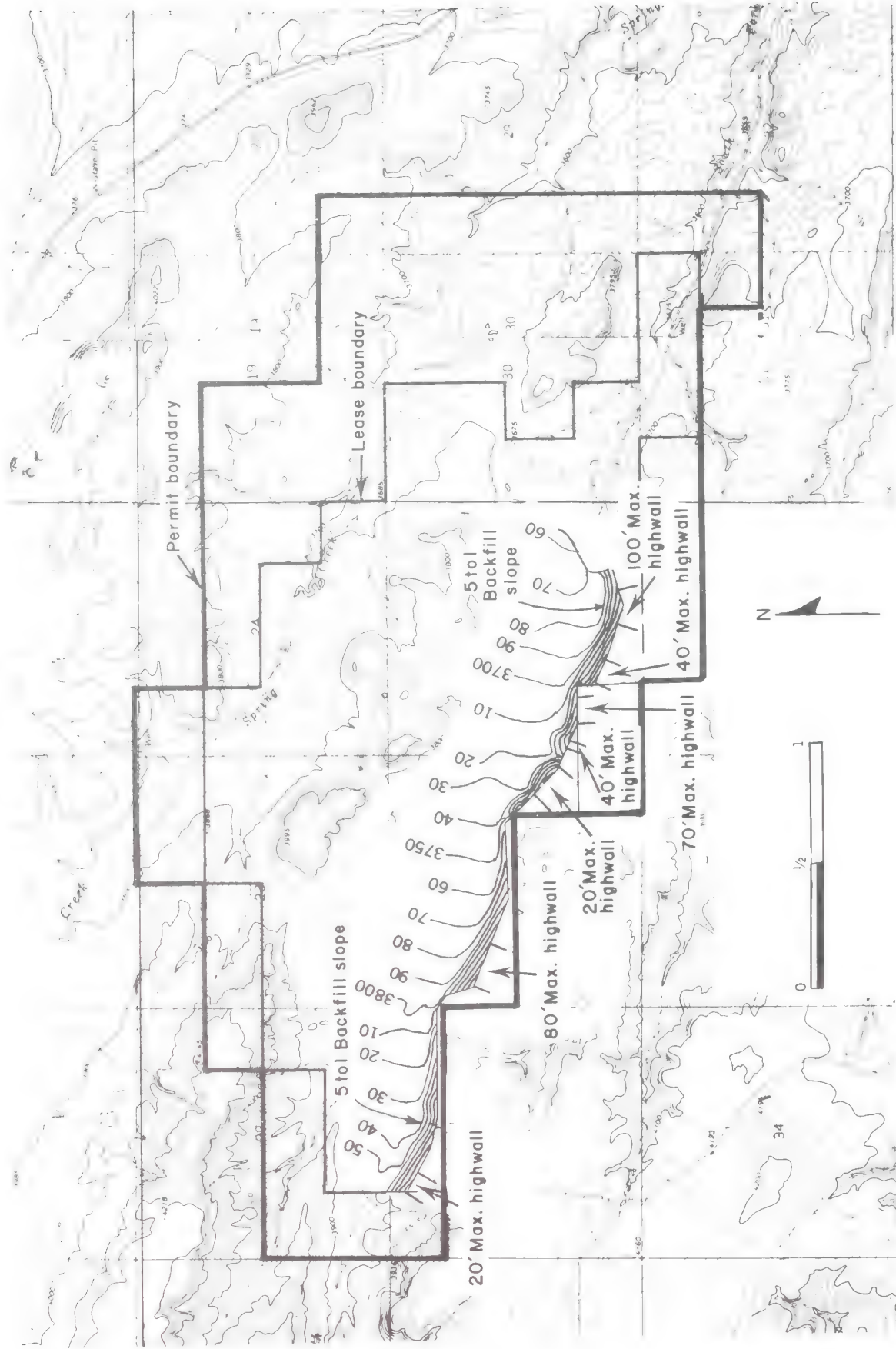


FIGURE VIII-2.--Case 2 - Highwall reduction.

of the borrow area material would be needed for backfilling. This would result in increased disturbance of 15 acres in addition to the area disturbed under the original mine plan. Leaving highwalls ungraded is contrary to the Surface Mining Control and Reclamation Act of 1977, the rules and regulations pursuant to that Act, and the emergency rules and regulations pursuant to the Montana Strip and Underground Mine Reclamation Act of 1973. Although there is a provision for alternative grading under the Montana law which might allow leaving highwalls, there is no such provision under the Federal law.

c. Case 3 (fig. VIII-3)

Under this case, the southern mining limit has been moved to the north, avoiding disturbance of the steeper slopes along the southern part of the lease area. By retracting the mining limit, 5.4 million tons of recoverable coal would be eliminated from the 243 million tons retrievable under the original mine plan (39 fewer acres would be mined in the area of generally steep terrain. As with Cases 1 and 2, the highwall along the southern boundary would be reduced by backfilling to a 5:1 slope. About 42 percent (213 acres) of the 508 acre borrow area would have to be disturbed to gain sufficient material to backfill the highwall. The net result of implementing Case 3 would be the disturbance of 65 fewer acres than under the original mine plan.

d. Impacts from the proposed highwall reductions

Impacts associated with highwall reductions would primarily involve geomorphology, vegetation, and wildlife. Other disciplines in the physical environment (hydrology, soils, climate, and air quality) would be insignificantly changed from those impacts forecast in chapter III.

Highwall reduction Cases 1, 2, and 3 would be subject to much the same erosion and sedimentation problems as the regraded highwalls proposed in the original mine plan. The backfilled highwalls would intercept the drainages of several ephemeral tributaries to South Fork Spring Creek. Because no attempt would be made to integrate these drainages with the reclaimed channel of South Fork Spring Creek, these drainages would be subject to erosion that would spread headward off the permit area. As in the original plan, approximately 700 acres south of South Fork Spring Creek would be affected. Excess sediment produced by this erosion would be deposited on the sloping plane of the reclamation surface, hindering revegetation attempts.

In all three cases, backfilled slopes would be subject to sheet wash, rill, and gully erosion. The severity of the erosion is related to slope length. Case 1, which would have the longest backfilled slopes, would be subject to the most severe erosion. Case 3 would have the shortest slope lengths and would be the least susceptible to erosion. Case 2 would have an intermediate susceptibility to erosion.

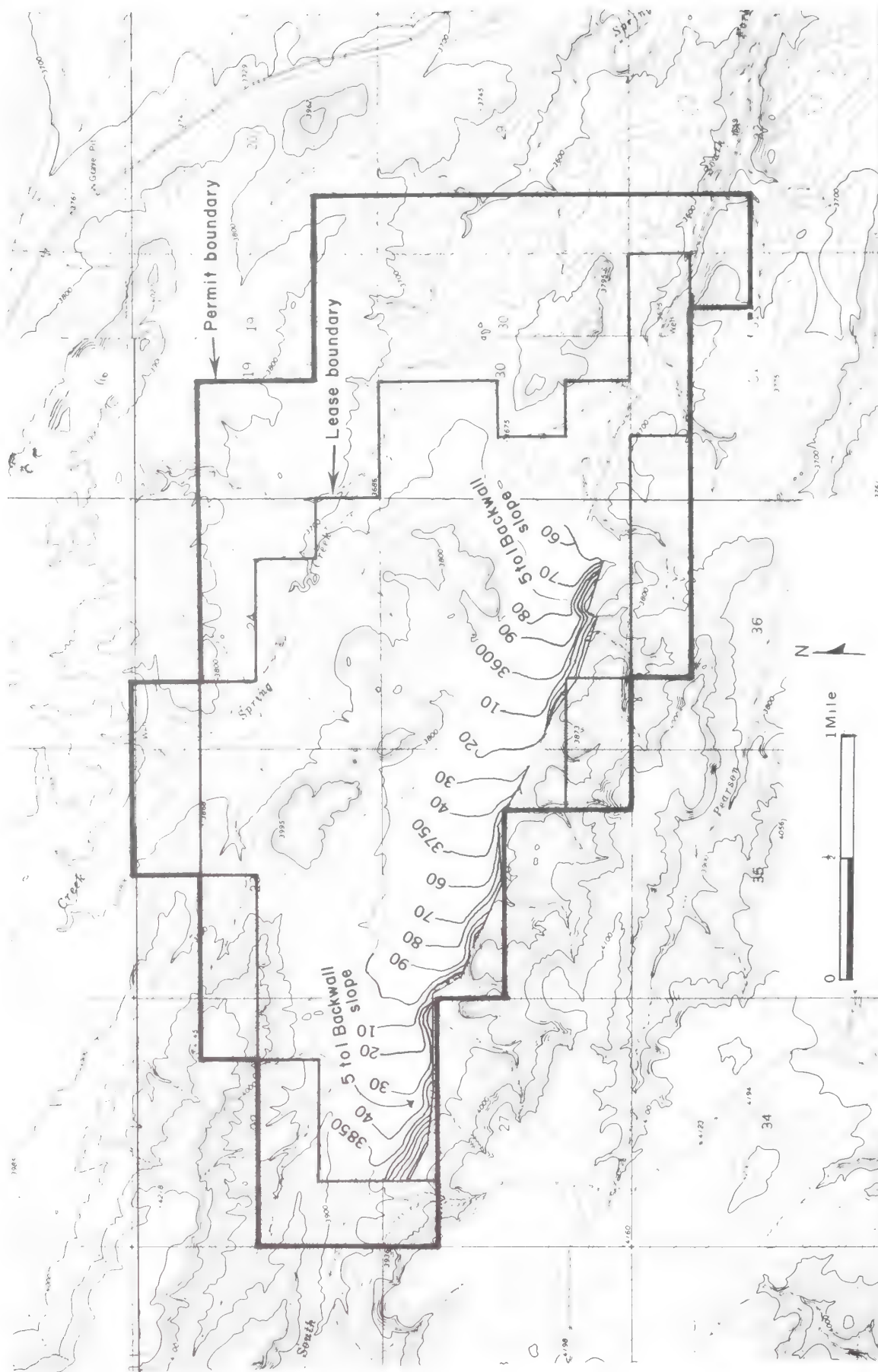


FIGURE VIII-3.--Case 3 - Highway reduction.

Case 2 differs from the other two cases in that it proposes to leave portions of highwall. This highwall would form cliffs, and would more closely resemble the natural topography.

Impacts to vegetation arising from the increased disturbance in Cases 1 and 2 would be completely offset by avoiding the disturbance of the ponderosa pine and upland shrub vegetation along the southern mining boundary.

Impacts associated with increased disturbance within the borrow area, for all three alternatives, would insignificantly alter the impact analysis in chapter III for wildlife. In Cases 1 and 2, 145 fewer acres of wildlife habitat, including ponderosa pine/juniper, would be disturbed along the southern portion of the mine area. Under Case 2, standing portions of highwalls would create potential cliff habitat for wildlife. In Case 3, an additional 39 acres (184 acres total) of generally steep terrain and important wildlife habitat would be left undisturbed in the southern portion of the mine area. Under all three cases, impacts to wildlife would be somewhat reduced, principally impacts to mule deer and small mammals.

E. ALTERNATE MINING PLAN - CENTRAL FIELD MINE PLAN¹

1. Background

On August 11, 1978, NERCO, in behalf of Spring Creek Coal Co., made a formal submittal of the Central Field Mine Plan to the Montana Department of State Lands and the Office of Surface Mining. In response to the enactment of the Surface Mining Control and Reclamation Act of 1977 (Public Law 95-87) and the Department of State Lands' letter of January 12, 1978 (appendix Q), the company modified its original mining plan to eliminate disturbance of those areas which might be interpreted to meet the definition of "alluvial valley floors" in section 701(1) of the Surface Mining Control and Reclamation Act and the Interim Regulations (ARM 26-2.10(10)-S10291(3)) which were adopted pursuant to the Montana Strip and Underground Mine Reclamation Act of 1973. The Department of State Lands has made a preliminary determination that both Spring Creek and South Fork Spring Creek, within the confines of the coal-lease area, meet the geomorphic characteristics of the definition of alluvial valley floors (appendix S). Also considered in its decision to modify the original mine plan, the company has avoided the disturbance of those areas which might be subject to the selective denial provisions (section 82-4-227 MCA) under the Montana Strip and Underground Mine Reclamation Act.

The mining and reclamation plan discussed in this section represents not only the company's response to the above-mentioned concerns, but also

¹Significant modifications have been made in this section to reflect new material obtained subsequent to the issuance of the draft. Changes in this section, therefore, will not be underlined.

the company's response to a letter dated November 29, 1978, which outlines deficiencies noted by the Department of State Lands and the Office of Surface Mining in its review of the Central Field mine plan (August 1978) application (appendix R). Because the application contains new data, information, and explanations obtained subsequent to the circulation of the draft environmental statement (DES 78-30), a discussion of the application must be presented to comply with Rule ARM 26-2.2(18)-P290(3)(d). This discussion portrays the most up-to-date mining and reclamation plan on which a decision is pending.

Principal differences between the Central Field mine plan and the original mine plan (discussed in chapter I) are in the amount of coal to be mined, the amount of land surface to be disturbed, the regraded post-mining topography, the water-diversion system, and the initiation of mitigatory measures. Associated facilities, their location and construction, would be basically the same as under the original mining proposal.

2. Proposals of the Spring Creek Coal Company

In accordance with the Central Field Mine Plan, coal recovery would be confined to the central portion of Federal (BLM) lease M-069782. This area is bounded on the north by a boundary line about 150 feet south of the limits of alluvial materials in the Spring Creek drainage and bounded on the south by a boundary line about 150 feet north of the alluvial materials in the South Fork drainage (See figure VIII-8.) The revised mining plan anticipates the recovery of about 184 million tons of coal from the 3,074-acre permit area; a reduction of about 59 million tons recoverable under the original mine plan. As discussed under "Description of the Coal Resource" in chapter I, the plans call for the extraction of the Anderson, Dietz I, and Dietz 2 coal beds which have merged in the mine area to form essentially a single bed averaging 81 feet in thickness. Production from the mine would be 2 million tons the first year, 6 million tons the second year, and 7 million tons each year thereafter.

a. Construction of facilities

Mining facilities described in chapter I would not be substantially changed; however, the administration office would not be built. Coal handling facilities would operate at less than the design capacity of 40,000 tons per day: average daily production from the mine and crushing facilities would be about 28,000 tons per day based on a 250-day operating schedule. The coal truck dump would be contained in a shed enclosing it on three sides; the primary and secondary crushers and the loadout facilities would be equipped with baghouses; and all conveying transfer points would have water-spraying devices. These controls have been designed for the abatement of coal dust emissions from the coal handling facilities.

Because Spring Creek and South Fork Spring Creek would not be disturbed during mining, no major diversions of these stream channels

would be required. No diversions would be required on South Fork; however, two minor diversions on Spring Creek would be required. Those relocations, shown in figure VIII-4, would be established during the first year, due to construction of haul roads and coal handling facilities south and west of the railroad loop, and would exist throughout the life of the mine.

Approximately 175 feet of channel in the SE1/4 sec. 24, T. 8 S., R. 39 E., at an elevation of 3,678 feet, and 950 feet of channel in the SW1/4 sec. 19, T. 8 S., R. 40 E., from an elevation of 3,666 feet to 3,662 feet, would be relocated to the south of the existing channel.

These relocated channels would have a generally trapezoidal-shaped cross-section with a bottom width of 20 feet, a side slope ratio of 2:1, and a minimum depth of 7.5 feet. The channels are designed to pass 1,500 cubic feet per second with freeboard. The stream gradient would be preserved by constructing the diversions with approximately the same length as the natural meanders, thereby retaining the same flow velocity as the preexisting natural channel during the infrequently occurring flow events.

The shorter channel relocation would be excavated in clinker; therefore, no lining would be required. Instead of riprap lining, the longer diversion channel would be revegetated as much as possible to obtain a maximum permissible velocity of 5 feet per second. Furthermore, a transect section of the relocated channel would be made to monitor erosional activity.

Surface runoff outside the mine drainage area (upstream and downstream from the mine) would follow its natural course into either Spring Creek or South Fork Spring Creek. With the exception of the two short diversions of Spring Creek discussed above, waters within the channels of Spring Creek or South Fork Spring Creek would be undisturbed as they flow through the permit area. It is expected that the quality and quantity of these flows would be unaffected by the mining operation, and, unless contrary findings demonstrate the need for further protection, extraordinary measures would be limited to protecting the mine workings from potential flooding.

Surface water originating within or flowing through most of the disturbed mine area, and inflow pumped from the mine pits, would be collected by a drainage control system and diverted to a main sediment control pond before it is discharged into the natural drainage of Spring Creek (figure VIII-5). In addition to the main sediment control pond, water would be settled, evaporated, or allowed to infiltrate into the ground in small sediment traps formed at the intersection of gullies with benches or drainage ditches. Sumps would also be used to aid water control and maintain safe operating conditions in the pits. The main sediment control pond, with overflow spillway at an elevation of 3,620 feet, would have a surface area of 14 acres and a storage capacity of 140.6 acre-feet. It would be adequate for impounding the predicted



FIGURE VIII-4.--Stream diversions on Spring Creek.

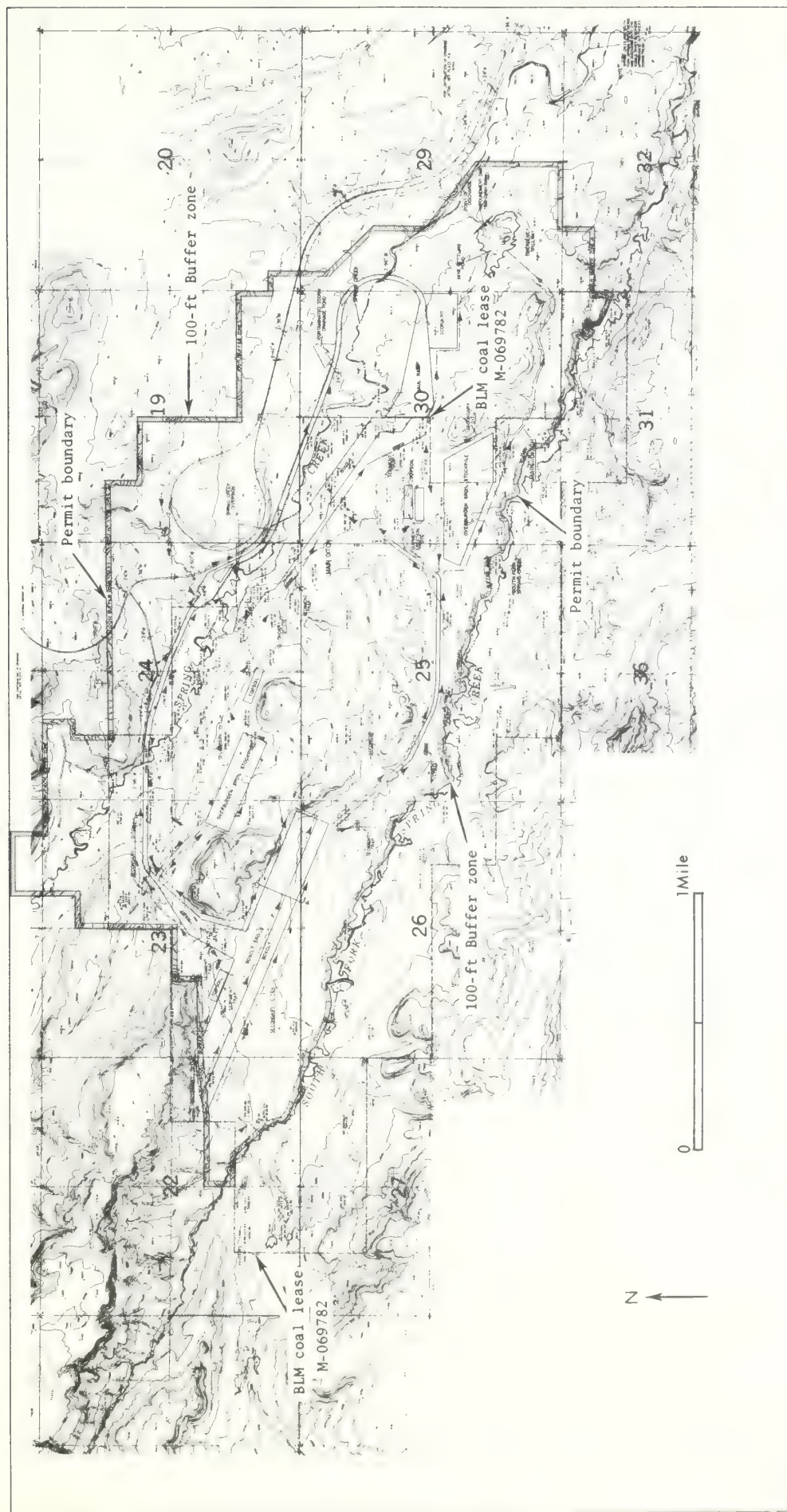


FIGURE VIII-5.--Drainage plan map.

runoff of 102 acre-feet from a drainage area of 1,810 acres during a 100-year, 24-hour storm having a total precipitation of 3.35 inches (and calculated net runoff of 0.68 inch). The pond would also hold an anticipated 35 acre-feet of sediment trapped during the 25-year life of the mine. A cross section of the sediment control dam is shown in figure VIII-6.

It is not anticipated that water discharged from the settling pond would need chemical treatment prior to release into natural drainage ways. All discharges would be monitored and conducted in accordance with the Montana Pollution Discharge Elimination System under appropriate permits issued by the Montana Department of Health and Environmental Sciences. Based upon the quality of actual discharges, Spring Creek Coal Company would add additional treatment facilities, as necessary, to meet the requirements of the Department of State Lands and the Department of Health and Environmental Sciences.

No deep mining has been or is presently being conducted adjacent to the proposed permit area. Therefore, Spring Creek Coal Company would not be discharging any drainage into or through existing deep mine workings.

The integrated system of runoff-control ditches, termed "secondary" and "main," depending on their design capacities, is shown in figure VIII-5. Cross-sections of ditches are shown in figure VIII-7.

Secondary ditches would be designed and constructed to carry the peak flow (11 cfs) from a 10-year, 24-hour storm resulting in a projected runoff of 0.17 cfs/acre from within the mine disturbance area. The company cites references showing that earth-lined ditches should not exceed a velocity of 3.5 ft/s and that channels vegetated with a smooth brome mixture should not exceed 5 ft/s. In order to keep flow velocities from exceeding 3.5 ft/s during a discharge of 11 cfs, all secondary ditches would be designed for a minimum of 1.4-foot depth and 4.2-foot top width, and for all slopes to be maintained between 0.004 and 0.014. In addition, a minimum of 1.0-foot of freeboard would be maintained on the downstream side of the secondary channels. Secondary ditches, unless temporary, would be recovered with topsoil and revegetated. Secondary ditches to be used for less than 1 year are considered temporary. As the mining and reclamation progresses, location of the main drainage ditches would change, but the channel sizes and flow characteristics would remain the same. Ditches would carry water only intermittently and would, therefore, be topsoiled and revegetated. The vegetation species mix would be the same used on stream banks and stream bottoms. (See table VIII-2).

Each secondary ditch would drain into one of two main drainage ditches: one receiving runoff that flows toward Spring Creek and the other receiving runoff that flows toward South Fork Spring Creek. All water intercepted by secondary ditches would flow through one of the two main drainage ditches into the settling pond. In a few instances, secondary ditches that drain small surface areas would carry runoff to small sediment traps. Drainage would flow from these traps to secondary ditches which ultimately flow into the settling pond. In no case would water

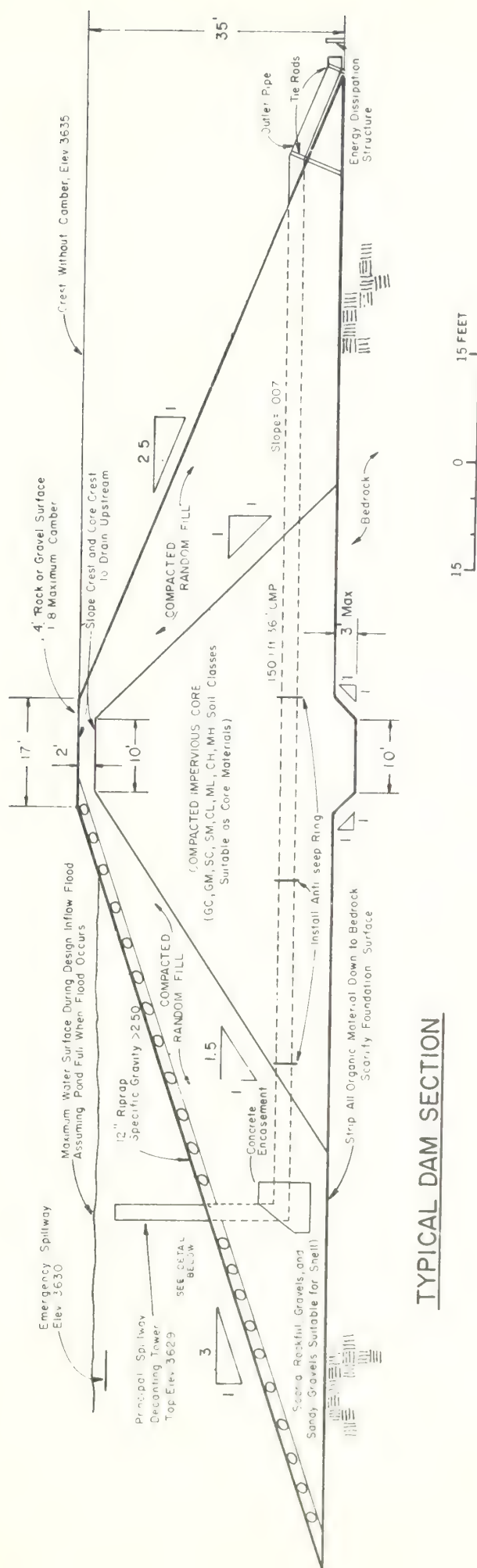
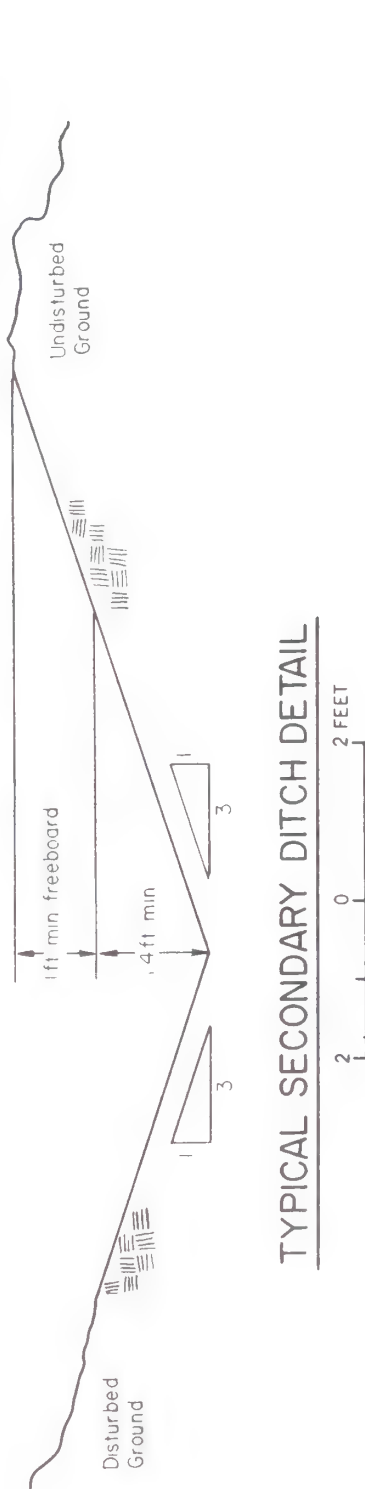
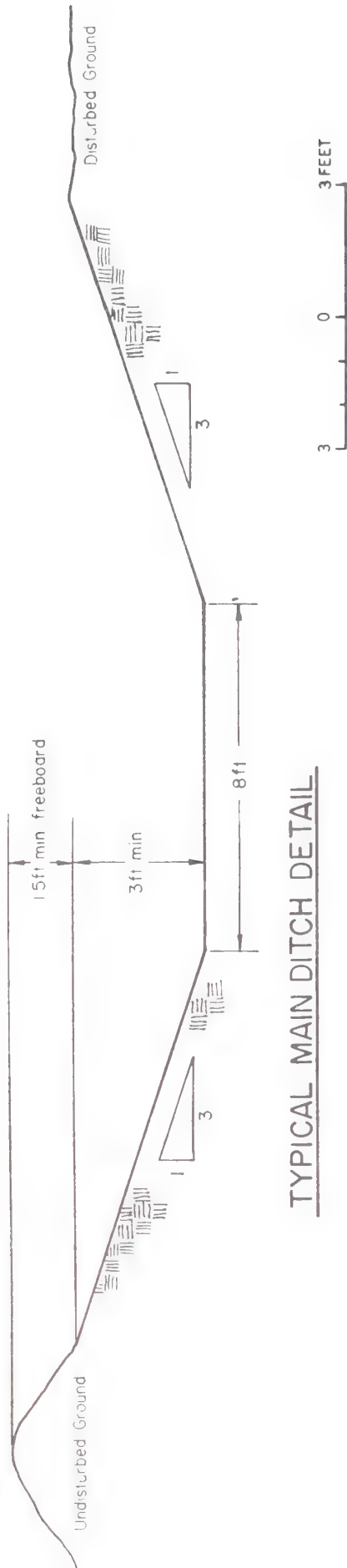


FIGURE VIII-6.---Cross section of sediment control dam.



SPRING CREEK DIVERSION CHANNEL

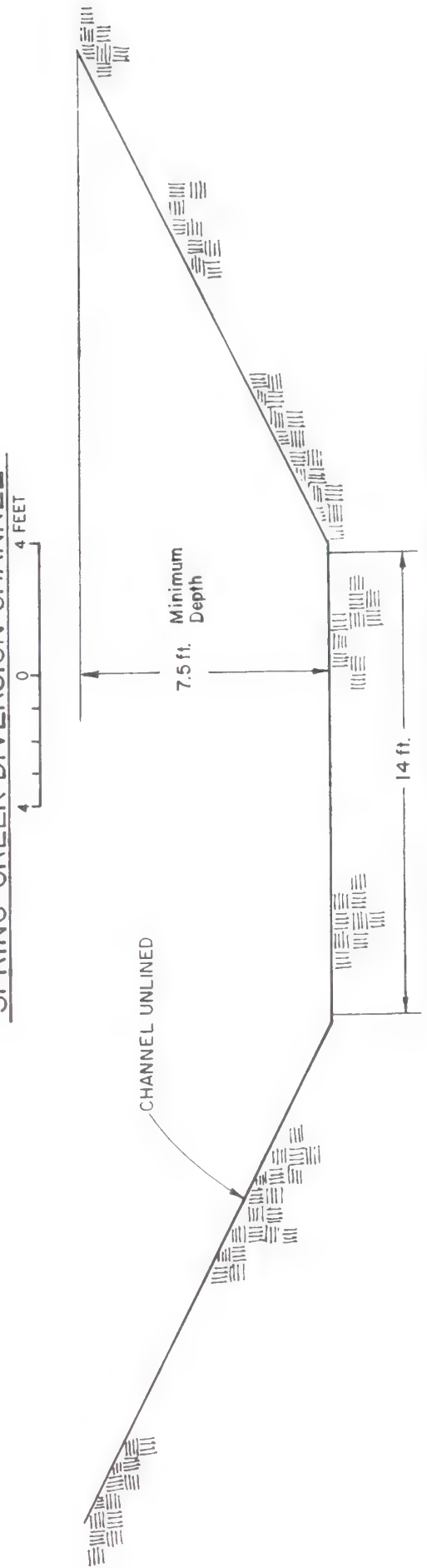


FIGURE VIII-7.--Drainage ditch cross sections.

entering secondary ditches or main drainage ditches from disturbed areas flow into natural drainage without first passing through the settling pond.

Both main drainage ditches would be designed to carry the projected runoff from a 100-year, 24-hour storm at a velocity less than 5 ft/s. As shown in figure VIII-7, they would be 8 feet wide at the bottom, with 3:1 side slopes. They would have a minimum depth of three feet upstream of sec. 30 (T. 8 S., R. 40 E.) and a minimum depth of 4 feet in secs. 30 and 29. At a depth of 4 feet and a slope of 0.004, a flow of 385 cfs would have a velocity of 4.8 ft/s. To maintain slopes of 0.004 in the main ditch channels, 3-foot drop structures would be constructed having 4:1 slopes. (See figure VIII-12). Each drop structure would require the placement of 12-inch-diameter stone (80 lb each) on the sloping drop and 10 feet on either side of the drop. To minimize erosion of the banks, channel curvature would not be less than 100-foot radius. A freeboard of 1.5 feet would be maintained on the downstream side of each ditch.

b. Mining

During the first 2 years of the initial 5-year permit, two boxcuts would be opened using conventional stripping and mining equipment. The first boxcut, in the southwestern portion of the mine area, would be excavated by a dragline during mining-year 1 (figure VIII-8). Beginning at the haulroad, the dragline would strip overburden and cast the spoil material to the north on an area from which topsoil had been previously salvaged. Stripping would proceed toward the northwest to the western boundary of the mine area. Upon reaching the western boundary, the dragline would be "walked" back to the beginning of the boxcut and extend the boxcut to the southeast, again casting the spoils to the north. The southwestern boxcut would be completed during mining-year 2.

At the same time the dragline begins stripping operations in the southwestern pit, a truck and shovel fleet would begin stripping the top 40 feet of overburden along the northeastern boundary of the mine area. Spoil material removed by this operation would be stockpiled at two locations--one stockpile to the west and one stockpile to the south. Upon completion of the boxcut in the southwest, the dragline would be walked to the northeast pit via the dragline corridor. Beginning at the haulroad, the dragline would strip overburden, casting the spoil material south of the boxcut, proceeding northwestward. The northeast boxcut would be completed by the end of mining-year 2. Because the spoil material would be cast to the south, rehandling of this material by the dragline would be necessary during the next two to three cuts. The dragline would alternate between the southwestern and northeastern areas, making successive cuts and casting the spoil material into previously mined-out areas.

Upon completion of its stripping operation in the northeast boxcut, the truck and shovel fleet would begin stripping the high overburden (above the 120-foot coverline) of the central bluff area in advance of the

dragline. Spoil material stripped by the truck and shovel fleet would be transported to areas which have insufficient spoil materials to achieve the proposed reclamation contours. Reclamation of those areas disturbed by mining would not commence until about mining-year 4.

Two active pits would be maintained throughout the life of the mine in order to provide operational flexibility and equalization of stripping ratios. During the first 5 years of mining, various levels of disturbance would be in accordance with table VIII-I. Mining of coal would ultimately disturb about 1,400 acres within the 3,074 acre permit area (figure VIII-9). Should the alluvial valley floor question be resolved by the determination that the valleys are not significant to a farming operation and that the company can preserve or restore the essential hydrologic functions, the company would seek a permit amendment allowing them to mine to the south within the lease boundaries and increase their production schedule to 10 million tons per year.

1) Topsoil removal and storage

All available and suitable topsoil (Horizons A, B and C) would be removed before any excavation, drilling for blasting, mining, or other surface disturbances, including the preparation of areas for stockpiling of overburden. Locations of all stockpiles are shown in figures VIII-5 and VIII-8.

TABLE VIII-1.--Acres disturbed during the first 5-year bonding period

Year	Direct mining	Bonding levels (acres)		Buffer zone area	Total acres
		Facilities area	Associated disturbance		
Preproduction--1979	21	1,624	1,288	141	3,074
Production----					
1980	372	1,273	1,288	141	3,074
1981	496	1,149	1,288	141	3,074
1982	604	1,041	1,288	141	3,074
1983	691	954	1,288	141	3,074
1984	778	867	1,288	141	3,074

Depths of suitable topsoil material have been determined, based upon premining soils inventory in the permit area. Where topsoil materials are determined to be suitable for salvage, all of the A horizon, as identified by soil surveys and the 100-foot grid pattern survey, would be removed separately. If the A horizon is less than 6-inches thick, it would be removed as part of a 6-inch-deep scraping operation, and would be stockpiled separately. Should the A horizon, or material with chemical and physical characteristics equivalent to those of an A horizon, be thicker than 6 inches, the entire unit would be salvaged in a single lift.

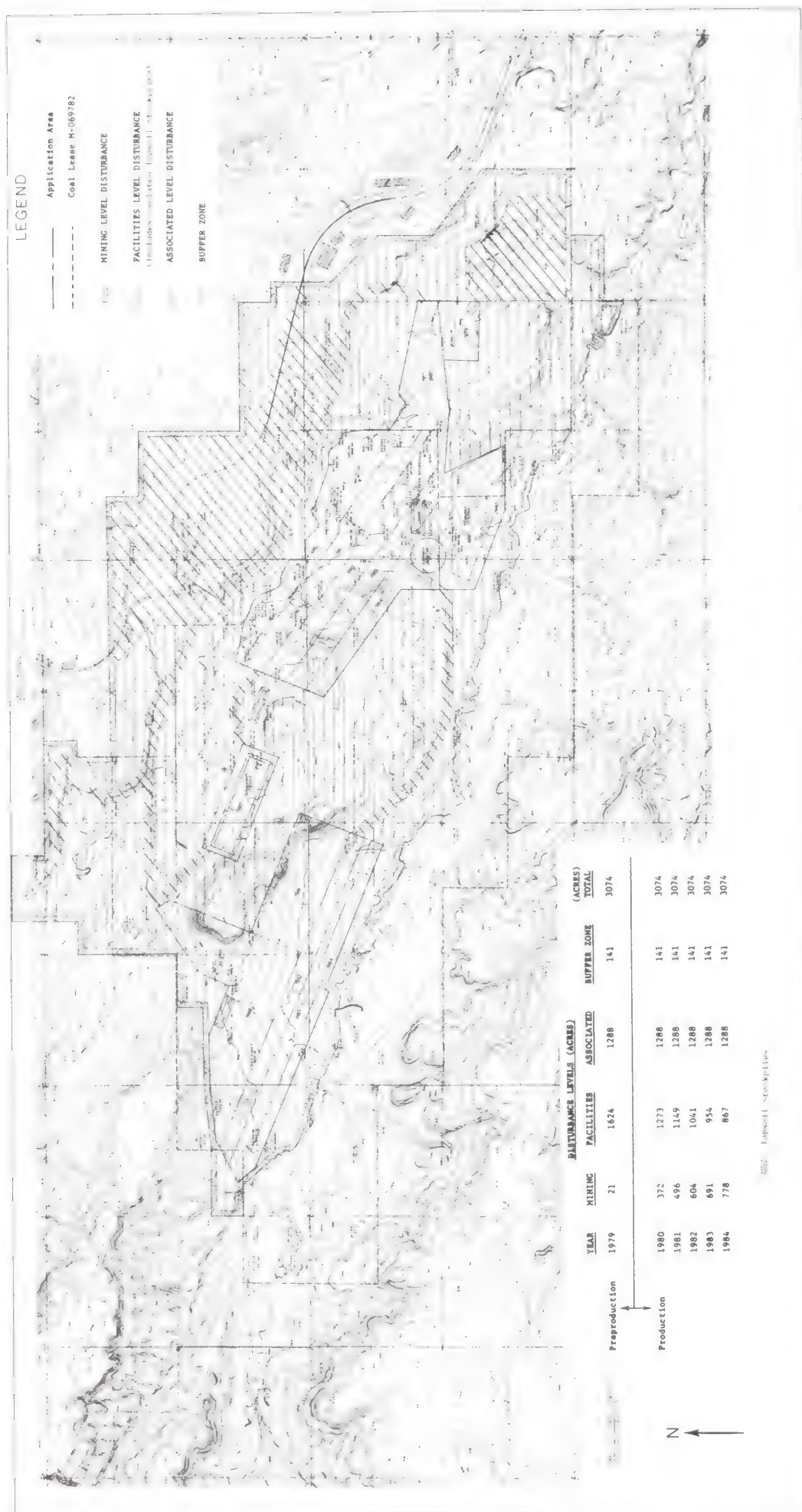


FIGURE VIII-9.--State bonding level map.

All soil material from the B and C horizons potentially capable of supporting plant growth would also be removed to its full depth and stockpiled separately from the A horizon materials. The thickest soils would be salvaged to a depth exceeding 5 feet, the average salvage depth being about 1.7 feet over a mapped area of 1,297 acres. The volume of topsoil material available for reclamation would be about 2,200 acre-feet.

Topsoil would be stored in stable areas within the permit boundary where it would not be disturbed. Stockpiles would be protected from excessive water or wind erosion which might cause waste or lessen the soil's capability to support vegetation. In addition, the stockpiles would be protected from unnecessary compaction by limiting heavy equipment traffic over them. In areas where significant amounts of surface flow would be generated upslope from the stockpiles, secondary ditches would be constructed to intercept water flowing toward the stockpiles. In addition, secondary ditches would catch runoff from the stockpiles.

In order to stabilize topsoil stockpiles to resist erosion, the company would seed them in accordance with methods approved by the Montana Department of State Lands. Other methods which can provide equal protection, such as snow fences, non-toxic chemical binders, and mulches might be used if approved by the Department of State Lands. Unless formally approved, stockpiled topsoil would not be moved or otherwise disturbed until required for redistribution on a properly prepared regraded spoil area. Where a regraded area has been sufficiently prepared for redistributions of topsoil materials immediately following their salvage, the intermediate step of stockpilings would not be used.

2) Overburden and coal removal

After the topsoil has been salvaged, overburden would be stripped from those areas which would undergo coal extraction. Because of the variable thickness of the overburden, a two-step system of stripping is planned where the overburden is more than 120 feet thick. A large mining shovel and truck fleet would remove the overburden above the 120-foot coverline, in advance of the dragline, and would either stockpile the overburden for future use in reclamation or place it in areas requiring additional fill material to establish the final reclamation grade. The remaining overburden (120 feet thick or less) would be removed by the dragline operating in a typical side-casting fashion. The company anticipates that blasting, loading, and dumping would cause overburden to expand in volume by about 25 percent; however, some compaction (possibly as much as 5 percent) would result from long-term settling and the movement of heavy equipment during grading and the replacement of topsoil.

The coal seam would be recovered in a two-lift sequence (about 40 feet per lift) using electric mining shovels. After being drilled and blasted, the coal would be loaded into haul trucks for transportation to the primary crusher. The coal recovery process would occur simultaneously in two separate pits within the mine area.

c. Reclamation

As stated in chapter I, Spring Creek Company proposes to reclaim all mining- and associated-disturbance areas in accordance with applicable State and Federal laws. Except for the area surrounding the facilities, which would be reclaimed upon the completion of construction, reclamation would not commence until mining-year 4 (figure VIII-10). Reclamation proposals in the Central Field mine plan differ from those in the original mine plan in the following respects:

- . Handling of spoils and the addition of spoil amendments.
- . Topographic relief and reestablishment of ephemeral drainage.
- . Handling of topsoil.
- . Vegetation seeding mixtures and selected plantings.

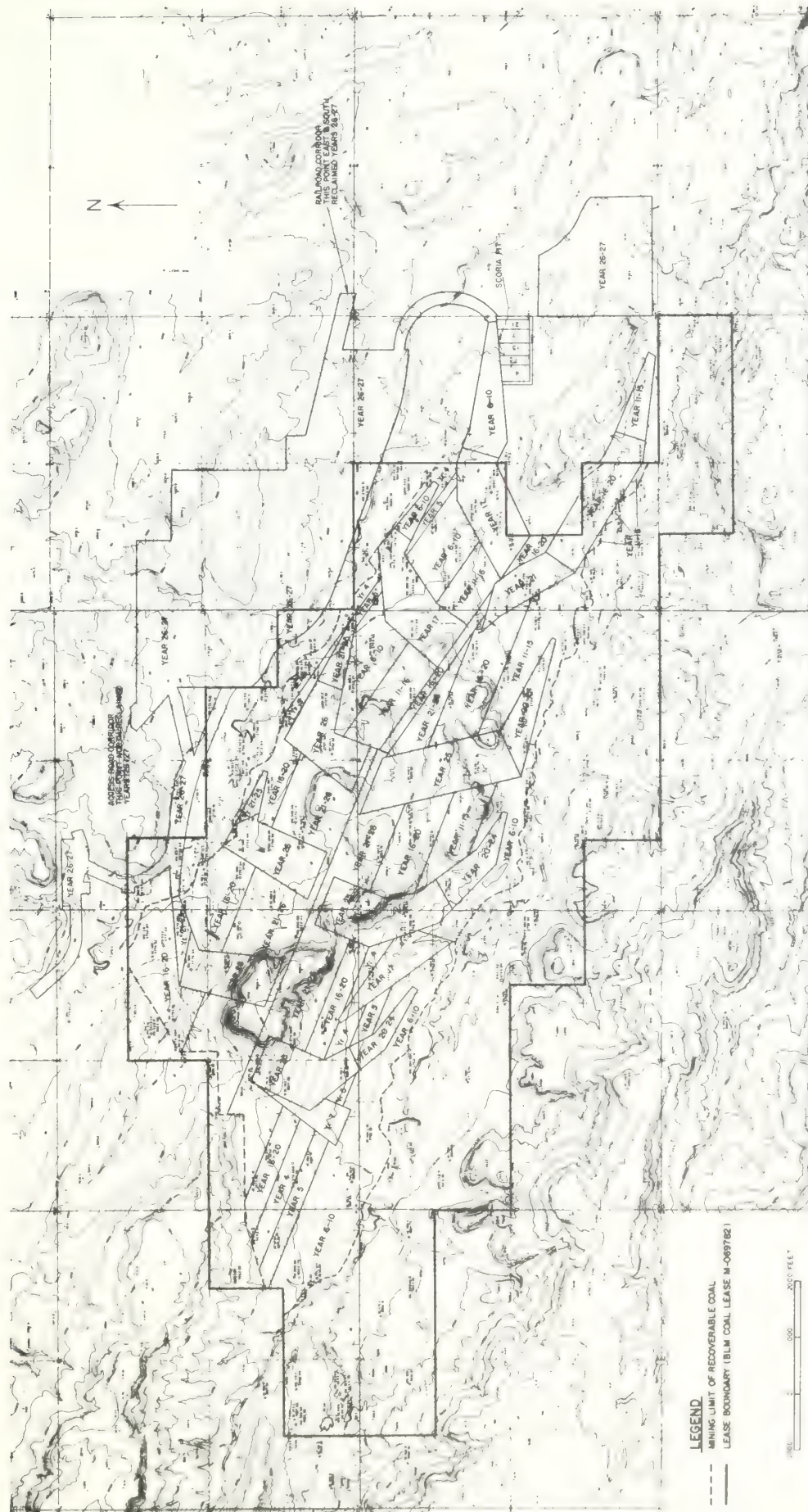
1) Spoil reclamation

Overburden removed during the coal stripping process would be placed in the pit following coal removal. Materials not conducive to revegetation, as determined by field and laboratory testing, drill log data, soil surveys, or a 100-foot grid survey, would not be left on top or within 8 feet of the regraded spoils surface.

Backfilled materials would be selectively placed and compacted to prevent leaching of toxic-forming materials into surface or subsurface waters and wherever necessary to ensure stability of the backfilled materials. Wherever coal seams are exposed in the final pit, the pit would be backfilled to cover them with at least four feet of non-toxic, noncombustible materials, to prevent ignition of the coal. This same procedure would be followed for stripping areas where temporary suspension of mining operations over a prolonged time might cause spontaneous combustion of the coal.

After mining operations in an area are completed, the overburden material would be recontoured using tractor dozers, scrapers, and graders. The regraded areas would be deep ripped to eliminate compaction and to produce a rough surface with which topsoil would form an effective bond. Deep ripping would allow for improved water percolation and would develop root-channeling areas in spoil materials. In addition, the roughened surface would deter wind and water erosion and catch moisture.

Spring Creek Coal Company would conduct extensive research in order to elucidate the long term effects of deep ripping as a deterrent to future concentrations of sodium salts in near surface materials. Other deterrent measures which may be used, as experimental options (preceding topsoiling) are (1) the addition of gypsum to the recontoured spoil surface and (2) addition of a thin layer (3 to 4 inches) of coarse-textured materials to



the spoil surface. After topsoiling, should an upward accumulation of sodium occur in the long term (5 to 10 years), the company suggests that the addition of an organic mulch, such as straw, would ameliorate the problem.

All backfilling and grading would be completed within 90 days after the Montana Department of State Lands has determined that the mining operation is completed, or that a prolonged suspension of work in the area would occur. In areas affected by strip mining, all grading and backfilling would be not more than two spoil ridges behind the working pit. The spoil from the working pit would be considered the first ridge. It would require approximately two years to commence revegetation of an area following coal removal. The reclamation sequence is shown in figure VIII-10.

Reclamation of other disturbed lands would be conducted as soon as possible. Areas disturbed in the construction of support facilities, such as roads, the maintenance shop, coal handling structures, and loadout facilities would not be completely reclaimed until the conclusion of mining operations. Areas surrounding these facilities, however, would be reclaimed upon completion of construction.

2) Postmining topography and reestablishment of ephemeral drainages

The objective of the proposed backfilling and grading process is to achieve a reclaimed surface which would provide a variety of topographic features similar to the premining topography, as shown in figure VIII-11. Slope reduction, backfilling, and grading would eliminate highwalls, spoil piles, and depressions. To achieve the desired postmining topography, high relief areas would be selectively redistributed within the mine area to produce topographic diversity with gentle slopes not to exceed 5:1 (about 11°).

Drainage basins would be reclaimed to their approximate premining size and locations. Drainage channels would be constructed to carry runoff from a 100-year storm. To simulate more natural conditions, a slightly meandering vegetated channel, lying within the larger drainage channel, would be designed to carry a 10-year storm flow (figure VIII-12). The main and secondary catchment ditches used during mining operations would be regraded and revegetated to conform with the postmining recontoured surface (figure VIII-11).

Two other main drainage ditches would be installed during reclamation to intercept drainage from the reclaimed surface, as shown in figure VIII-4). These ditches would be vegetated and would take drainage to the settling pond. The two ditches would be designed to carry a 10-year, 24-hour peak flow because of their temporary nature. The ditches would be 2.6 feet deep, 4 feet wide at the bottom, with side slopes of 3:1. In order to keep flow velocities below 5 ft/s, a gradient of 0.008 would be maintained by using 3-foot drop structures having short slopes of 4:1 protected from erosion by 12-inch diameter stone riprap, similar to those used in the larger

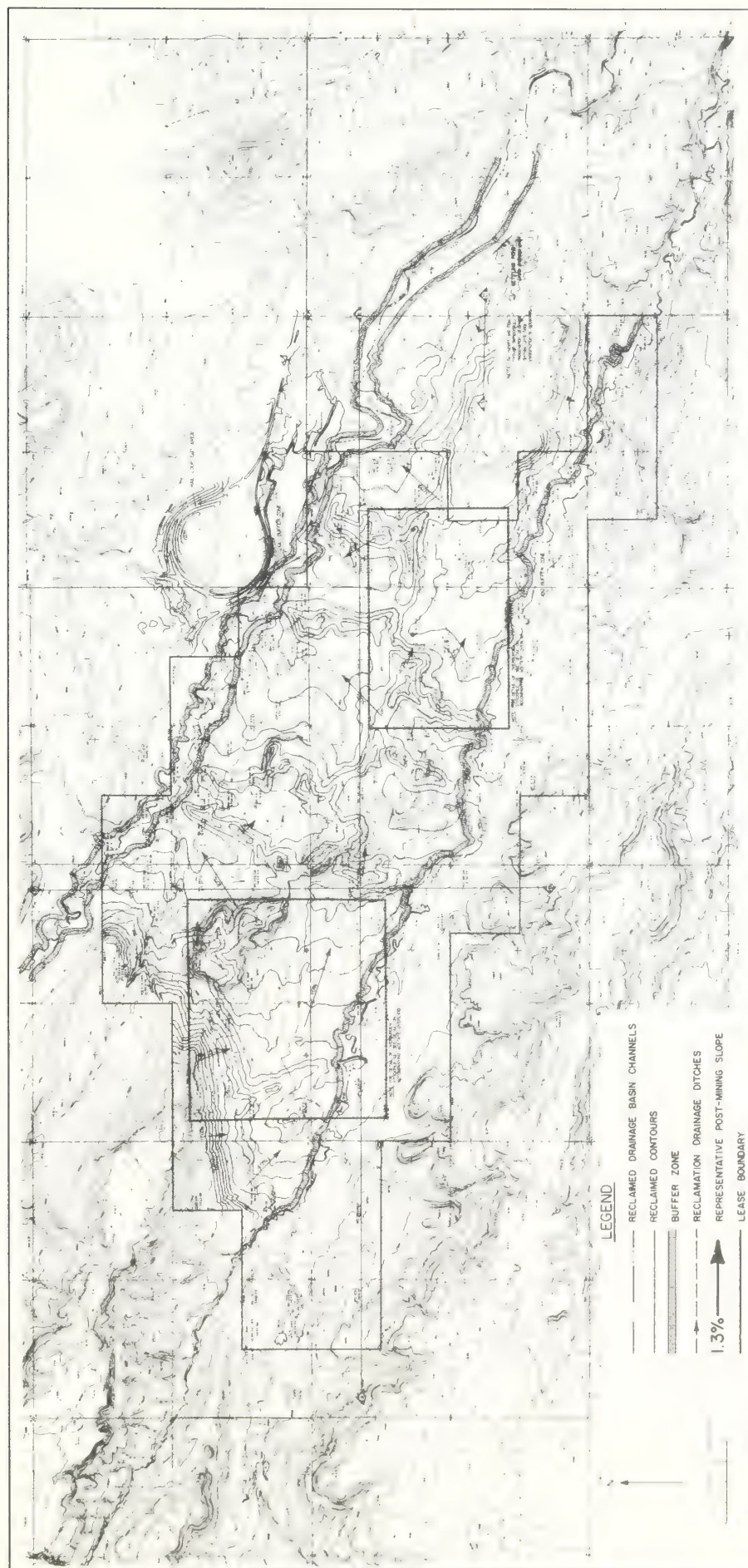
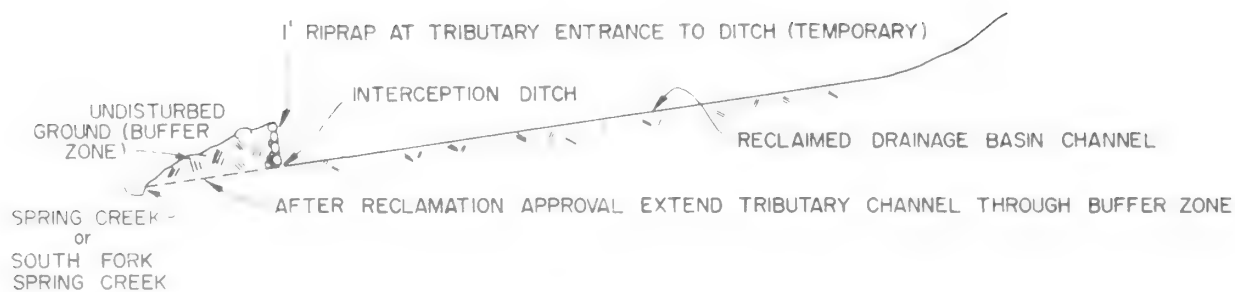
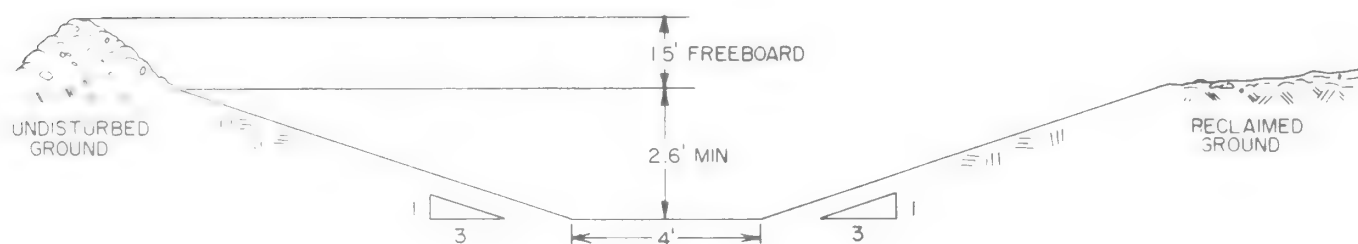


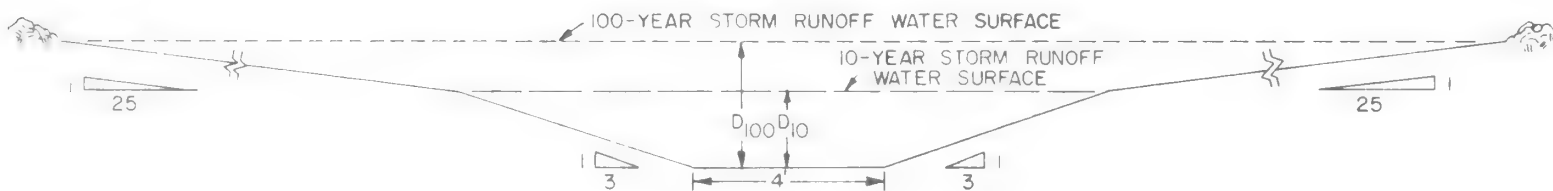
FIGURE VIII-11.--Postmining recontoured surface.



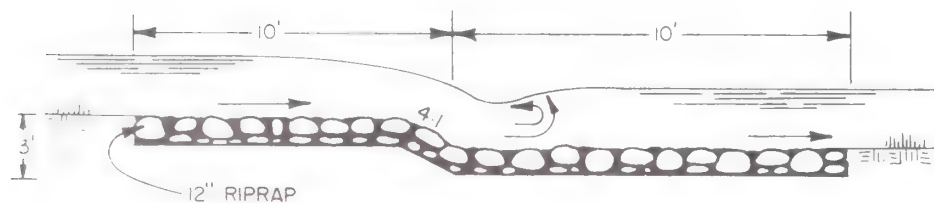
TYPICAL RECLAIMED DRAINAGE BASIN CROSS-SECTION
AT INTERSECTION OF RECLAIMED TRIBUTARY WITH
SPRING CREEK - SOUTH FORK



TYPICAL RECLAMATION DRAINAGE DITCH



TYPICAL RECLAIMED DRAINAGE BASIN CHANNELS



TYPICAL SLOPED CHANNEL DROP

FIGURE VIII-12.--Reclaimed stream cross sections.

capacity main drainage ditches during mining. In addition, 12-inch-diameter stone would be temporarily placed on the downstream side of the ditch at the entrance of each tributary basin, to prevent ditch washouts. To minimize erosion of the banks, channel curvature would not be less than a 100-foot radius.

Channels in the reconstituted drainage basins would be designed and constructed to a point where approximately one-half of each drainage basin remains. Above this point, channels would be allowed to form naturally. If major gullies form, they would be reclaimed again and, if needed, the drainage channel extended farther into the basin to prevent a recurrence of erosion. Erosion that does occur would be prevented from reaching Spring Creek and South Fork Spring Creek by the main interception ditches.

Following approval of reclamation by appropriate regulatory agencies, the interception ditches would be removed and drainage basin channels would feed directly into their premining channels through the buffer zone to Spring Creek and South Fork Spring Creek. Erosion would be monitored, and stabilization measures would be taken if stabilization does not occur naturally. Riprap would not be used unless deemed necessary.

No permanent impoundments are proposed as part of the final reclamation plan. The sediment control pond shown in figure VIII-4 would be removed as the final stage in the reclamation process.

If any settling of the reclaimed surface occurs, material from spoil stockpiles would be used to maintain the designed topographic surface. Under this amended mining and reclamation plan, there would be no scarcity of backfill materials because there would be approximately 23,000,000 bank cubic yards of surplus overburden from the "central bluffs" area. One-half of this material, 11,500,000 bank cubic yards, would be stockpiled to facilitate backfilling in areas of subsidence, should they occur during mining or following final grading and reclamation. If these stockpiles are not needed for this purpose, they would be contoured and reclaimed in such a fashion as to blend with the topography established in the regular reclamation plan. The other half of the surplus spoils would be used to create the proposed diverse topography. Surplus spoils would actually be stockpiled in the form of diverse topographic features within the rectangular areas shown on the map, figure VIII-11. The dual objectives of subsidence control and establishment of diverse topography would make it possible for the company to conduct an empirical evaluation of the 25-percent spoil swell factor expected to apply at this site, while preserving available surplus materials for use in spot filling and diverse topography establishment, as necessary.

3) Topsoil redistribution and topsoil amendments

After final grading of the spoils to the proposed postmining specifications, the spoil surface would be scarified to a depth of about 3 feet by a tractor equipped with rippers. This treatment would loosen surface compaction of the spoils and create a roughened surface to which the

topsoil would adhere. Within 90 days prior to seeding, topsoil would be placed on all areas scheduled for seeding and allowed to settle. About 12 inches of B and C horizon material would be placed on the regraded spoils, followed by an application of about 6 inches of A horizon material. The company estimates the volume of the available topsoil material (combined A, B, and C horizons) to be about 2,200 acre-feet, or enough to cover the entire reclaimed surface to a depth of about 21 inches.

Following topsoil redistribution, compaction would be kept to a minimum by limiting travel over these areas. A dryland chisel plow, running to a depth of about 12 to 14 inches, would be used to further prepare the seedbed and to protect the topsoil from wind and water erosion. Topsoil would be tested on each 2 acres to gather any information necessary and to determine which topsoil amendments would be necessary to achieve optimum results. The company proposes to construct a laboratory at the minesite which would be used to analyze soils as potential plant growth media, to analyze plant tissues, and to maintain optimum soil management during reclamation. Specific analyses would measure the following soil components:

- . Texture,
- . Soil pH and soluble salts,
- . Organic matter and nitrate,
- . Sodium,
- . Extractable phosphorus and micronutrients (zinc, iron, manganese, copper),
- . Exchangeable potassium,
- . Borax and selenium,
- . Estimated percentage of lime (CaCO_3).

In accordance with the results of such analyses, the following kinds of amendments would be applied:

- . In case of nitrogen loss from fertilizers due to leaching, a split application of fertilizer would be made in order to avoid nitrogen deficiency late in the season.
- . Only adequate amounts of phosphate would be used, in order to control zinc and iron deficiencies which may arise due to excessive phosphate applications.
- . Field testing would be incorporated into the ongoing program of revegetation, and results shared with other agencies or individuals. Very low applications of micronutrients, such as zinc, iron, copper, and manganese would be tested in the field and in a greenhouse, to determine requirements of those nutrients by native species.
- . Salt and sodium amendments would be carefully managed in accordance with treatment methods currently used or developed through ongoing research.

If the seedbed is prepared in the spring, a cover crop of millet would be planted to increase organic matter in the soil and to increase soil moisture from snow trapped by the stubble. Permanent grass would be seeded in late fall directly into the millet stubble.

If the seedbed is prepared for fall seeding, weed-free straw mulch will be crimped into the soil, prior to seeding, at the rate of two tons per acre. The company would use both mulching and cover crops in the spring and fall on slopes over 10:1 until it has been determined by the Montana Department of State Lands that the use of both mulching and cover crops is unnecessary.

4) Planting and revegetation

Planting and revegetation of all mining areas would take place during the first appropriate season following grading and topsoil redistribution, not to exceed 90 days from the date of seedbed preparation. Should seedbed preparation be completed in the spring, a cover crop of millet would be sown at a rate of 25 pounds per acre, and, in the fall, perennial species would be seeded directly into the stubble. If the seedbed is prepared in the fall, a weed-free straw mulch would be crimped into the soil at a rate of 2 tons per acre, immediately followed by the drill-seeding of perennial vegetation. Normally, seedbed preparation would be completed by mid-June; therefore, a cover crop of millet would be seeded.

One general and two special seeding mixtures have been developed for reclamation purposes (table VIII-2). The general seeding mixture would be applied over the major portion of the minesite; one of the special seedling mixtures would be applied to the highwall reduction areas; the other special seeding mixture would be applied to streambanks (figure VIII-11). The species selected for seeding and/or planting were chosen on the basis of available information on soils, overburden, vegetation, wildlife, and climate at Spring Creek and are intended to provide a diverse, permanent cover with a seasonal variety, distribution, and regenerative capability similar to existing vegetation. The company proposes to keep the number of species seeded in the initial reclamation planting low in order to minimize interspecific competition. All drill-seeding would be done on the contour, at 7- to 10-inch intervals, and soil amendments would be added, if determined to be necessary by topsoil testing.

As indicated in table VIII-2 and depicted in figure VIII-13, some tree and shrub species would be transplanted in selected areas to ensure establishment and to create desirable wildlife habitat. Substrate modifications, such as the selective placement of coarse-textured materials in the areas proposed for planting ponderosa pine and skunkbush, would be used if substrate conditions are not suitable for plant establishment.

The company would use locally grown genotypical seed or other plant materials, when available in sufficient quality and quantity. In some cases, alternate species would be used if seed supplies of native species are limited, or if a particular characteristic (or localized variation) is desired.

TABLE VIII-2.--Proposed seeding mixtures for the Spring Creek project site
(rates in pounds of pure live seed per acre)

Amount	Botanical name	Common name
General seeding mixture		
0.5	<u>Artemisia tridentata</u> var. <u>wyomingensis</u> *	Wyoming big sagebrush
0.5	<u>Atriplex confertifolia</u> *	Shadescale
0.5	<u>Rhus trilobata</u> *	Skunkbush sumac
0.5	<u>Atriplex canescens</u>	Four-wing saltbush
0.5	<u>Ceratoides lanata</u>	Winterfat
3.0	<u>Agropyron smithii</u>	Western wheatgrass
2.0	<u>Stipa viridula</u>	Green needlegrass
1.0	<u>Bouteloua gracilis</u>	Blue grama
1.0	<u>Oryzopsis hymenoides</u>	Indian ricegrass
1.0	<u>Andropogon scoparius</u>	Little bluestem
1.0	<u>Sitanion hystrix</u>	Bottlebrush squirreltail
3.0	<u>Agropyron dasystachyum</u>	Critana thickspike
0.5	<u>Astragalus cicer</u>	Cicer milkvetch
0.5	<u>Onabrychis viciaefolia</u>	Sanfoin
1.0	<u>Artemisia frigida</u>	Fringed sagebrush
1.0	<u>Achillea millefolium</u>	Common yarrow
1.0	<u>Penstemon strictus</u>	Rocky Mountain penstemon
Highwall reduction mixture		
0.5	<u>Rhus trilobata</u> *	Skunkbush sumac
0.5	<u>Chrysothamnus nauseosus</u> *	Rubber rabbitbrush
0.5	<u>Atriplex confertifolia</u>	Shadscale
0.5	<u>Ceratoides lanata</u>	Winterfat
0.5	<u>Astragalus cicer</u>	Cicer milkvetch
3.0	<u>Agropyron dasystachyum</u>	Critana thickspike
3.0	<u>Agropyron smithii</u>	Western wheatgrass
2.0	<u>Agropyron inermis</u>	Beardless wheatgrass
2.0	<u>Stipa viridula</u>	Green needlegrass
2.0	<u>Calamovilfa longifolia</u>	Prairie sandreed
2.0	<u>Bouteloua gracilis</u>	Blue grama
1.0	<u>Artemisia frigida</u>	Fringed sagebrush
1.0	<u>Penstemon strictus</u>	Rocky Mountain penstemon
Streambanks seeding mixture		
0.5	<u>Artemisia cana</u> *	Silver sage
3.0	<u>Bromus inermis</u>	Smooth brome
3.0	<u>Agropyron smithii</u>	Western wheatgrass
3.0	<u>Agropyron inerme</u>	Beardless wheatgrass
2.0	<u>Calamovilfa longifolia</u>	Prairie sandreed
2.0	<u>Agropyron riparium</u>	Streambank wheatgrass
2.0	<u>Elymus cinerius</u> *	Basin wildrye
(transplants)	<u>Prunus virginiana</u>	Chokecherry
(transplants)	<u>Salix exigua</u>	Sandbar willow
(transplants)	<u>Populus angustifolia</u>	Cottonwood (narrow leaf)

*Transplants will be used to ensure establishment.

3. Description of the Environment

The existing environment in the Spring Creek area is described in chapter II.

4. Environmental Impacts of the Proposal

a. Geology

The Central Field Mine Plan would reduce or eliminate many of the erosion and sediment problems identified in the original mine plan. Destruction of the stratigraphic sequence during mining would affect ground water, soils, and vegetation. There would be sufficient spoils material to reconstruct a reclamation surface more closely approximating a natural land surface than in the original mine plan.

Following reclamation, subsidence and erosion would cause local reclamation problems, which the company proposes to monitor and mitigate as they arise. The extension of drainage channels, by erosion, and subsidence of the reclamation surface would likely continue for several decades following reclamation, however, because of low, sporadic precipitation. Without continued management during this period of development, severe erosion problems such as gullying could develop, and subsidence could create local depressions that would inhibit revegetation. If the period of monitoring and management were extended beyond the period anticipated by the company, these potential impacts could be avoided.

If, in the future, the company were allowed to return to the original mine plan, spoils material would be insufficient to create a geomorphically stable land surface, and the impacts described in chapter III would be likely.

1) Topography and geomorphology

a) During mining

During mining, disturbance of the surface by men and machinery would cause accelerated erosion. The exact amount of this erosion is unknown. Hinkley and Taylor (1977) report that the sediment yield from a nearby watershed containing unreclaimed, abandoned mine spoils was eleven times greater than the natural sediment yield. Sediment yield during mining at Spring Creek would be increased, probably to a similar degree. Following reclamation these rates would again decrease, although not as low as premining rates.

A network of drainage ditches would collect storm runoff and most of the excess sediment, routing it to a settling pond near Spring Creek, as shown in figure VIII-5. However, not all drainage ditches flow to the settling pond. Drainage ditches located along the north haul road empty into Spring Creek and an increase in sediment would be added to the Spring Creek drainage from the northern haul road.

Water released from the settling pond to the natural drainage would be sediment deficient compared to natural stormflow. State and Federal regulations (ARM 26-2.10(10)-S10330; 30 CFR 715.17) allow for these waters to carry a suspended sediment load no greater than 45 mg/L or approximately 45 ppm. Wilson (1972) has reported that sediment concentrations of runoff from summer thunderstorms in the western United States are in excess of 10,000 ppm. Sediment-deficient runoff could cut into stream channel floors to obtain a natural sediment load. The alluvium along Spring Creek adjacent to the minesite is quite coarse, and is not very susceptible to erosion. Because of the coarse texture of the alluvium, surface flow would infiltrate. Stream incision could occur downstream, if there were sufficient surface flow, where alluvial sediments become finer (and therefore more susceptible to erosion).

Under this mine plan, no major diversions of Spring Creek or South Fork Spring Creek are proposed; therefore, the problems of increased erosion associated with the diversions proposed in the original mine plan would be eliminated.

b) Postmining

Under the Central Field mine plan, more spoils material would be available to reconstruct landforms than was available in the original mine plan. Instead of a long, broad, featureless plane, there would be a surface having some topographic diversity. Spoils material would still be insufficient to construct a surface closely similar to the premining topography. Surface elevations would be reduced 100 feet or more in the central bluffs area, and hillslope gradients would be reduced. Rock outcrops of the central bluffs area would not be reconstructed. Portions of the reclaimed surface would have very gentle slopes (1-3 percent). However, most of the surface would have sufficient relief to enable overland flow to drain into reclaimed channels. The creation of some relief, as proposed, would reduce susceptibility to wind erosion.

The area south of South Fork Spring Creek would not be disturbed by mining, and the area of backfilled highwall would be reduced to a portion of the northwest boundary of the permit area, affecting considerably less land surface than under the original plan. The slope of the regraded highwall would not exceed 5:1; however, these slopes would be steeper than the premining slopes for the same area. Given the increased gradient, the unconsolidated nature of fill material, and decreased infiltration characteristics of disturbed topsoil, these slopes could be susceptible to severe erosion (rilling and gullying). If severe erosion were to occur, it would primarily be limited to the backfilled highwall. The excess sediment produced would accumulate at the foot of the regraded highwall, where it would inhibit vegetation. Only a small part, at most tens of acres, of the reclaimed area would be affected.

Only one major tributary crosses the northwest highwall. At this location, the drainage basin would be reconstructed and the reclaimed tributary integrated with both upstream and downstream drainage channels.

Channel slopes would vary, but would be kept within the range of slopes observed in the natural channel. The concave-upward longitudinal profile, typical of most stream channels, would be preserved. Such design does not guarantee that erosion problems would not develop, but it does reduce the probability of severe erosion problems.

Erosion rates on the reclaimed surface would be higher than on the natural surface, because of two main factors: increased runoff and increased erodibility. Infiltration rates after successful reclamation would be less than on unmined sites (Lusby and Toy, 1976; Arnold and Dollhopf, 1977), producing greater runoff. Irrigation studies conducted at the nearby Decker minesite indicate that after an initial wetting, permeability was greatly reduced (Gary Wendt, personal communication). In addition, the loss of soil structure reduces the topsoil to its constituent particles (sand, silt, or clay), making disturbed topsoil more erodible than undisturbed topsoil. The result of increased erodibility and decreased infiltration would be an increase in both surface flow and erosion. These effects may be partially offset by decreased hillslope gradients..

The geomorphic stability of the new reclamation surface would probably be greater than that of the surface discussed in chapter III. The reclaimed surface would be smoothly integrated with the surrounding landscape. All ephemeral drainages would be returned to the reclaimed surface. Reclaimed drainage basins would have the same drainage areas as the premining basins, would have approximately the same locations, and would join major stream channels (Spring Creek and South Fork Spring Creek) at approximately the same locations as premining drainages.

Ephemeral stream channels would be constructed to approximately the halfway points of the drainage basins. Further extension of the channels would be allowed to occur naturally. The constructed channels would be given meandering channel patterns, and would enter the main streams at lower gradients than before mining. Additional erosion or deposition would occur as the channels adjust to the equilibrium slope and channel pattern for the sediment load and runoff supplied from the reclamation surface. While mining and reclamation are still underway, the sediment produced by erosion would be collected in the settling pond. Severe erosion problems that develop would be mitigated by the company. The company anticipates that drainage extension would occur soon after reclamation, but erosion processes in a semi-arid region are very sporadic, and, as a result, channel extension may occur intermittently over a period of several decades following reclamation. Without continued management through this period of development, erosion could become severe and spread throughout individual reclaimed watersheds.

Reclaimed stream channels would be vegetated to reduce flow velocities. Although this technique is viable, it would make successful revegetation critical to maintaining channel stability. If toxic overburden should inhibit revegetation or if drought reduced vegetation at

a future time, the channels could be subject to severe erosion, possibly gullyng. This potential impact could be eliminated if the channels were redesigned to provide suitable velocities without vegetation.

The geomorphic stability of the Spring Creek minesite depends not only upon specifics of the proposed reclamation plan, but also upon processes acting in the downstream portions of the drainage basin. The alluvium along South Fork Spring Creek is finer in texture than that along Spring Creek and is therefore more susceptible to gullyng. If gullyng should spread up South Fork Spring Creek, either naturally or induced by future mining and reclamation at the North Decker minesite, it would spread to the reclaimed stream channels along South Fork Spring Creek, and the reclaimed surface could be subject to severe erosion.

The company cites a report (appendix D of the mine plan) indicating that most subsidence would occur within five years following reclamation. This report is based upon three study sites: the Decker mine (Montana) where the study area was reclaimed only five years previous; the Alcoa mine in east-central Texas (average precipitation 34 inches per year); and England (limited studies). The studies in Texas and in England both indicate that most subsidence occurred in the first five years following reclamation. Because the rate of subsidence is, in part, determined by precipitation (as the cited report indicates), the rate of subsidence at the Spring Creek minesite (where the average precipitation is 12 inches per year) would be less than in eastern Texas or in England. How long subsidence would continue at Spring Creek is presently unknown. No long-term subsidence studies have been conducted in the region. However, monitoring and management, continued over the long term until subsidence has stopped, would prevent subsidence from interfering with successful reclamation.

The company has proposed to monitor reclaimed areas for indications of subsidence and to fill such areas, if they develop, from surplus spoils that are stockpiled in the form of hills shown in figure VIII-10 (indicated by rectangles). If monitoring were stopped five years after reclamation because the company assumes most subsidence would occur within that time period, further subsidence could occur undetected. Thus, reclamation problems caused by subsidence could develop after bond release. Uncared for depressions would collect surface runoff, would accumulate clay sized particles, and would concentrate salts, thus inhibiting revegetation.

2) Overburden and stratigraphy

Under the Central Field mine plan, mining would irretrievably destroy the existing overburden stratigraphy. However, the area in which the stratigraphy would be destroyed is reduced from that of the original mine plan. Destruction of the local overburden stratigraphy would produce no significant impact in itself: the local stratigraphy is not unique, and has no intrinsic value.

Nonetheless, the Anderson-Dietz aquifer would be destroyed within the mine area. Overburden material would be crushed and soluble minerals exposed to solution affecting both the quality of ground water and near surface soil chemistry. The existing relationships among vegetation, soil, and bedrock would be disrupted, making revegetation more difficult. Some sodic and saline material within the overburden would unavoidably be placed near the surface during reclamation. (See chapter VIII, Soils.)

3) Paleontology

Anticipated impacts to fossils would be of negligible significance: no fossils of scientific interest are believed to exist in the overburden that would be disturbed at the proposed minesite. (See chapter III, Paleontology.)

b. Hydrology

1) Surface water

The surface-water supply would be reduced on the mine area, but stock ponds would remain undisturbed along South Fork Spring Creek. The amount of runoff and sediment load would be controlled, to keep them low, and the geomorphic stability and water quality of Spring Creek would be affected primarily by the quantity and rate of flow leaving the settling pond, as discussed above, under Topography and Geomorphology. Although erosion within the mine area is expected to increase during mining, the sediment yield from the area during mining could be less than normal because of required drainage controls. After mining, the sediment yield from the area would probably be near normal, because effects of increased erodibility of the reclaimed surface would be offset by the decreased gradients of reclaimed water courses.

Under the amended mine plan, stream diversions would be limited to two short segments of Spring Creek, as shown in figure VIII-4. No diversion would be required on South Fork Spring Creek. As a result, problems associated with diversions in the original mine plan, such as increased hillslope erosion and erosion of the diversion channels, themselves, would be eliminated. Three stock ponds and the perennially wet portion of South Fork would be left intact. Three other stock ponds, within the mine area--two on tributaries to Spring Creek (center of the E1/2 sec. 23; SE1/4SE1/4 sec. 24) and one on a tributary to South Fork (SW1/4NW1/4 sec. 25)--would be used as sediment traps in the system of catchment ditches during mining. These ponds would be eventually destroyed as a result of the mine.

2) Ground water

The main difference in ground water impacts between the original and the amended mine plans would be that under the revised plan the alluvial aquifers of Spring Creek and South Fork would be left intact, except for two short diversions on Spring Creek noted above.

A portion of the Anderson-Dietz aquifer would be destroyed but the area of disturbance would be less than under the original plan. Two wells adjacent to the permit area would be adversely affected. The water level in a well in the NE1/4NE1/4 of sec. 31 might drop to near the bottom of the hole, and the unused well in the west-central part of sec. 24 might become dry. Deeper aquifers exist to provide an alternate source of ground water.

With the lowering of the ground water table in the Anderson-Dietz aquifer in the vicinity of the mine, the effects may extend beyond the drying of nearby wells. Recent information submitted by the company suggests that there is no direct connection between the alluvial aquifers and the Anderson-Dietz aquifer. However, stream courses are commonly located along zones of weakness in the underlying bedrock. In areas underlain by nearly horizontal sedimentary strata, zones of weakness usually occur along fractures or faults. The extent to which the alluvial aquifer would drain depends largely upon the degree of hydraulic contact between the alluvium and the Anderson-Dietz coal aquifer, through the overburden. If there is little or no hydraulic connection, then the alluvial aquifer should not be adversely affected; the perennial spring on South Fork would remain, and two alluvial wells along South Fork Spring Creek would not dry up. If, however, there is sufficient movement of ground water from the alluvial aquifer through fractures in the overburden and along bedding planes, so as to cause drainage of the alluvium, the impacts would be the same as those described in chapter III except that the structural integrity of the alluvium itself would not be disturbed. It is considered unlikely that this would occur.

The quality of ground water would be decreased in the Anderson-Dietz aquifer east of the permit area. Dissolved solids leached from the spoils, probably dominated by magnesium and sulfate ions, would be carried downdip within coal and clinker aquifers east of the permit area. An indication of the water quality that might be expected is provided by ground water samples obtained from spoils at Decker. These samples contain about 4,300 mg/L dissolved solids, and may not be suitable for either domestic or livestock use. Water moving to the east would be diluted by local recharge but it is not certain that the water would be sufficiently diluted for livestock use. Leaching of the Spring Creek mine spoils would not be expected to add a significant amount of dissolved solids to the Tongue River.

c. Air quality

Air pollution from the revised mine plan would be less than that projected for the original plan: atmospheric concentrations of particulates and dustfall rates would be similar, although the area impacted would decrease slightly. Secondary air quality impacts on the biological environment would be similar in kind and magnitude to those discussed in chapter III.

1) Fugitive dust

Fugitive dust emissions from the Spring Creek mine would total 118,000 tons per year from 1985 until the end of mining (table VIII-3); this assumes that 51.6 percent of the "potential" 245,000 tons of fugitive dust would be controlled by company-proposed mitigations.¹ A 91.9 percent reduction in potential fugitive dust emissions could be achieved if the company, in addition to the controls it proposes, chemically treated haul roads with Coherex,² an organic dust sealant (U.S. EPA, 1979). This would decrease actual annual fugitive dust emissions to about 20,000 tons.

Figures VIII-14 through VIII-17 show the change in mean annual total suspended particulate (TSP) and dustfall during 1985 in the Decker area.³ The Spring Creek mine and the North extension and East Decker mines would combine to double downwind TSP concentrations and dustfall rates. The area that would be affected by these mines would approximately double. The Spring Creek mine would contribute about one-third of the total particulate emissions from the Spring Creek-Decker mining complex. Two to three miles downwind of the Spring Creek mine (but upwind of all other mines), the annual geometric mean for TSP and the monthly dustfall air quality standards would be violated (Federal and State annual geometric mean for TSP is $75 \mu\text{g}/\text{m}^3$ and the State dustfall standard is 15 tons/ mi^2 /three months). This implies that the 24-hour TSP standards would also be periodically violated downwind of the permit area. Dustfall would increase from a baseline of 6 tons/ mi^2 /month to greater than 31 tons/ mi^2 /month in the immediate vicinity of the mine. Visibility on Highway 314 between the Spring Creek mine and the North Decker

¹"Potential" fugitive dust emissions are defined by EPA as all uncontrolled fugitive dust emissions.

²Coherex applied initially at a rate of 1 gal/ yd^2 with a dilution of 1:4 and then applied once per month at a rate of 1/2 gal/ yd^2 , diluted 1:10, when rainfall does not exceed 0.01-inch during ten consecutive days (U.S. EPA, 1979).

³This dust dispersion model uses emission source strengths calibrated from the Western Energy Company mines in Colstrip, Mont. The sources at Spring Creek were modified by production level, surface area disturbed, and source configuration. The model does not reflect emissions calculated in table VIII-1 using EPA emission factors, but rather real TSP and dustfall values recorded at Colstrip. Thus the emission source strength represents actual or controlled emissions, not potential emissions. Since dust from the coal handling facilities at Colstrip is not as well controlled as is proposed for Spring Creek, the model may predict somewhat higher emissions from that source. However, since the model does not account for differences in aridity at these two locations (the Decker area is considerably drier than Colstrip) total dust dispersion or source strength may be underestimated.

TABLE VIII-3.--Actual annual particulate emissions from the Spring Creek mine after proposed dust control techniques are employed during 1985*

Permit area sources	Potential emissions (tons/yr)	Proposed control technology	Total dust	
			control efficiency (percent)	Actual emissions (tons/yr)
Overburden excavation-----	511.6	None.	0	511.6
Coal extraction-----	531.4	None.	0	531.4
Hauling materials-----	231,366.7	Water spray.	**50	115,683.4
Coal handling-----	11,165.0	Negative pressure dump, enclosed crusher, water transfer points, enclose conveyors and coal storage pile, install baghouses.	99	111.7
Fuel combustion-----	24.5	None.	0	24.5
Wind erosion-----	1,245.6	Cover crop topsoil piles.	5	1,183.3
Reclamation-----	178.3	None.	0	178.3
Total-----	245,023.1	Approximately	51.6	118,224.2

*See appendix D-3 for the detailed calculations of the potential particulate emissions during 1985.

**Richard and Safriet, 1977.

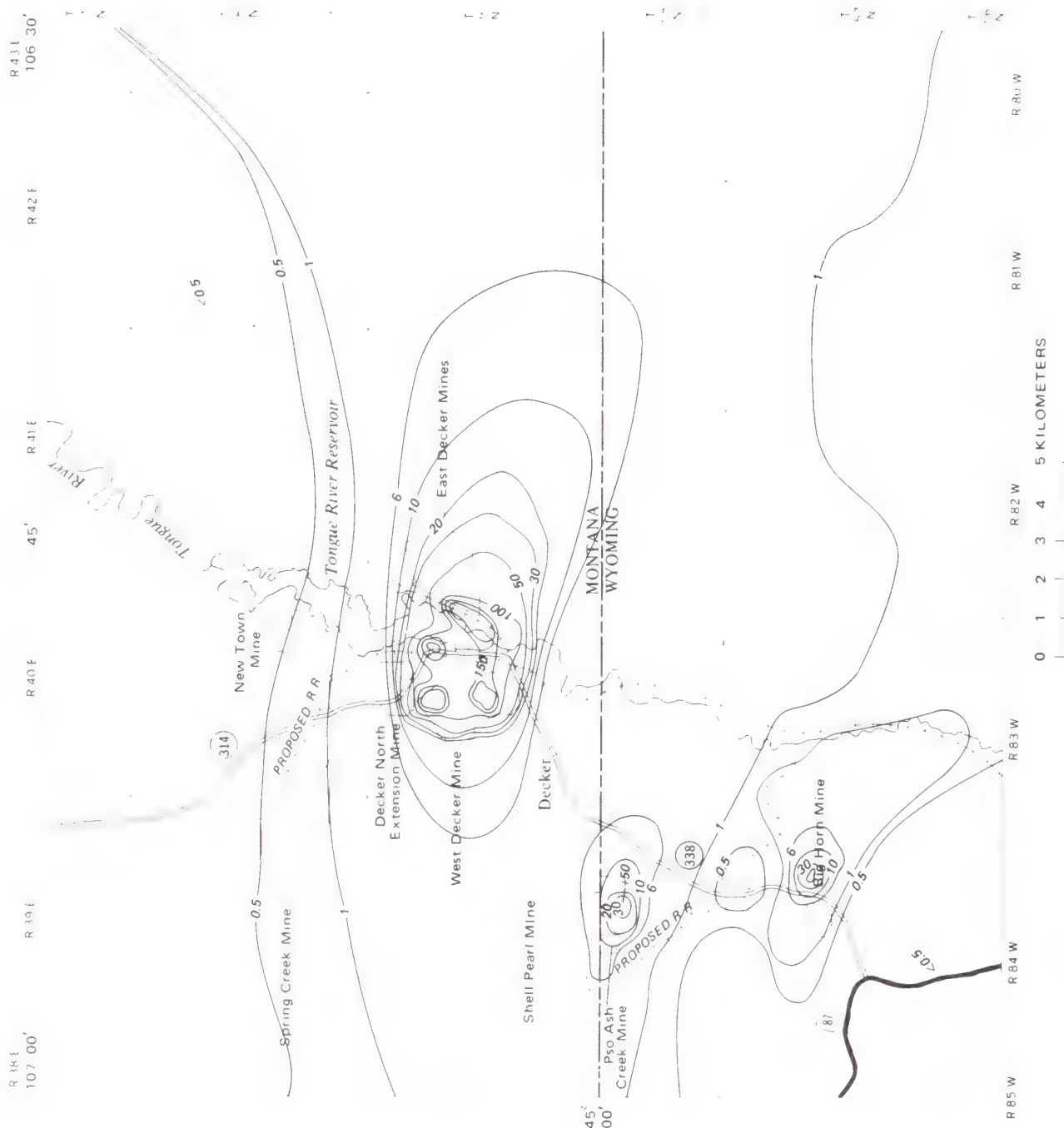


FIGURE VIII-14.--Baseline average annual total suspended particulate concentrations ($\mu\text{g}/\text{m}^3$).

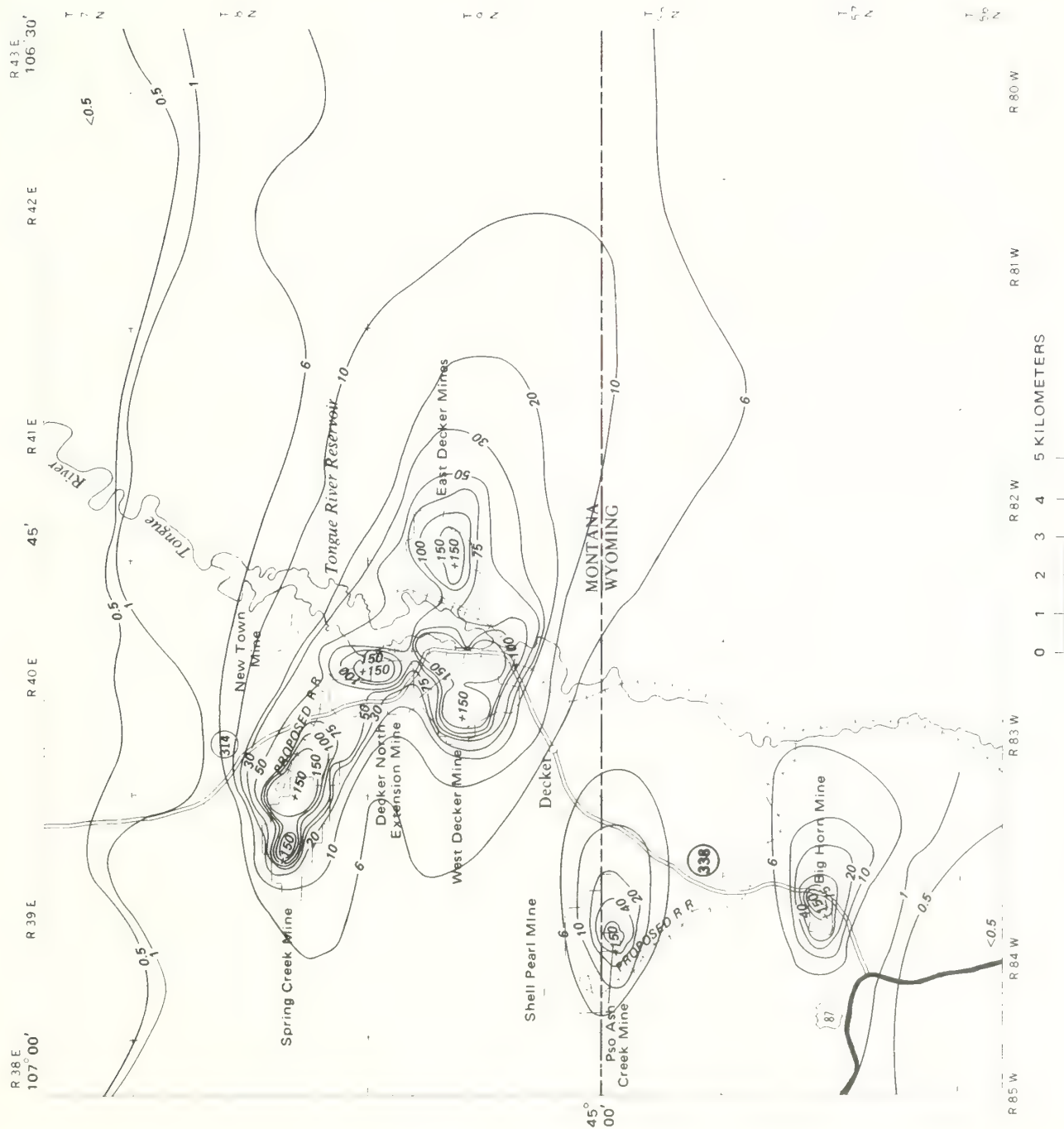


FIGURE VIII-15.--Projected average annual total suspended particulate concentrations ($\mu\text{g}/\text{m}^3$).

FIGURE VIII-16.--Baseline annual average dustfall (tons/mi²/mo).

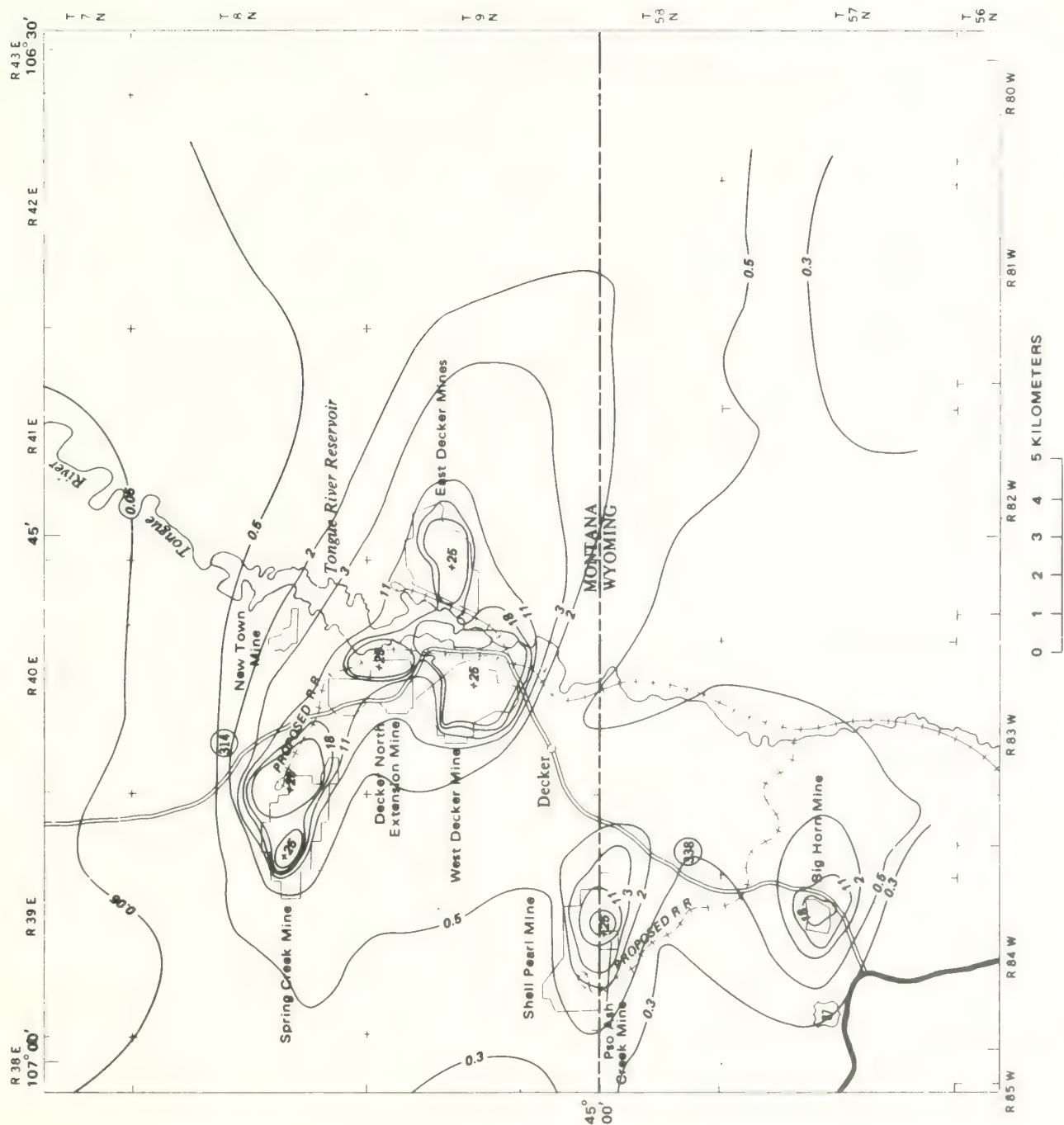


FIGURE VIII-17.--Projected average annual dustfall (tons/mi²/mo).

extension would be periodically impaired, especially during wintertime air stagnations, causing very hazardous driving conditions. Impairment of long-range visibility would generally be confined to the Tongue River drainage.

Other important sources of fugitive dust from the Spring Creek mine would be unit trains and the increased population in Sheridan County, Wyoming. Annual coal dust loss from unit trains would range from 0.28 tons/mi² to 560 tons/mi² along the railway corridor between the Spring Creek mine and a point 25 miles east of Sheridan, Wyoming (see appendix D-6 for discussion of emission rates). The latter emission rate would equal about 47 tons/mi²/month (assuming no seasonal differences in coal dust loss) which would be in violation of the Montana dustfall standard. The Spring Creek-induced population increase in the Sheridan County area, largely concentrated around the city, would increase particulate emissions by 30 tons in 1985, and 37 tons annually by 1990. (See appendix D-7.)

2) Gaseous emissions

Gaseous emissions from the Spring Creek mine would predominantly increase ambient concentrations of carbon monoxide, nitrogen oxides, and sulfur oxides (table VIII-4). Most of the carbon monoxide and hydrocarbon emissions would come from secondary development, while most of the nitrous oxides would come from diesel fuel combustion at the mine (table VIII-4). Mean annual concentrations of carbon monoxide in downtown Sheridan would increase by about 0.3 parts per million (ppm), a 2 percent change. Other gaseous emissions would be either too low to effect harmful changes in ambient concentrations, or would be dispersed over larger distances where population densities are low. However, long-term, cumulative additions of gaseous emission sources could begin to increase ambient concentration of these gases significantly, decreasing visibility and inducing minor health effects to the Decker-Sheridan area residents.

d. Soils

The amended Spring Creek mine and reclamation plan has a reasonable expectation of initial reclamation success. The company would monitor reclamation throughout the life of the mine and beyond, increasing the probability of long-term success. Problems due to saline soils have been adequately met by reducing the depth of "topsoil"¹ salvage. Sodium from the sodic overburden would probably still move upward into the overlying non-sodic "topsoil," despite mitigations specifically proposed by the company, with the effects on soil structure and revegetation success discussed in chapter III, Soils.

¹"Topsoil" is a common term with no exact meaning. Here it is used to denote any material derived from natural soil profiles suitable for or capable of supporting plant growth and meeting Montana Department of State Lands guidelines for salvage.

TABLE VIII-4.--Gaseous emissions from fuel combustion at the Spring Creek mine and vicinity during 1985

	SO ₂	CO	NO ₂	HC	Aldehydes	Hydrogen cyanide	Organic acids
	Permit area sources						
Diesel fuel-----	26.5	73.9	356.2	35.9	8.2	---	---
Gasoline							
Heavy duty vehicles							
and machinery-----	0.1	26.3	2.1	2.1	---	---	---
Light duty trucks-----	---	0.5	0.1	0.1	---	---	---
Locomotive, diesel-----	1.7	3.9	11.1	2.8	0.2	---	---
Ammonium nitrate							
Fuel oil mixture-----	---	71.4	60.0	---	---	0.2	---
Total-----	28.3	176.0	429.5	40.9	8.4	0.2	---
Regional area sources							
Population increase							
Sheridan area (505)---	222.2	717.1	166.7	126.3	---	---	---
Regional mobile sources							
Employee transportation ¹							
From Sheridan (194)	---	8.2	1.2	0.8	---	---	---
From rural Big Horn (26)	---	1.1	0.2	0.2	---	---	---
Locomotive ¹							
Diesel emissions-----	4,960.0	11,200.0	31,800.0	8,080.0	480.0	---	600.0

¹ Lbs/mile/year.

The reclaimed surface would be more stable and diverse than in the original plan, and thus vegetation would have a greater chance of successfully meeting reclamation requirements. The probability of long-term reclamation success is unknown, and would depend partly on how effectively the company treated the problem of sodic overburden. The mine would have those reclamation problems which are common to strip mines in the semiarid West (see chapter III, Soils), but these would not pose insurmountable difficulties under proper management.

The company has proposed to monitor soil and spoil characteristics before and after seeding, but it has not specified how it would monitor sodium after seeding, when it would take action, and what action it would take. Early detection of sodium movement into the topsoil, followed by effective mitigation, would prevent the topsoil from becoming sodic. But if sodium began to accumulate in the topsoil or if mitigation were ineffective, several hundred acres of topsoil could well become sodic, and that impact would be practically irreversible. It is possible that sodium translocation would be a slow or sporadic process, depending on soils, vegetation, and climatic conditions. Under these conditions, hundreds of acres would be nominally reclaimed, but affected by excess sodium. The company has not indicated how such lands would be treated.

The company proposes deep ripping of the graded overburden spoil before placing topsoil, a procedure commonly undertaken on regraded spoils. But deep ripping is unlikely to slow sodium movement for more than a few years because both the topsoil and the overburden are moderately fine textured (predominantly silty clay loam) and the clay minerals are primarily smectites and illites, which would shrink and swell with seasonal changes in soil moisture. After initial wetting in spring and early summer, these clays would expand and seal the interface between the topsoil and the underlying spoils, so accumulated sodium could not be flushed downward, out of the topsoil.

The company would use millet as a cover crop and mulch. The company believes that the millet would also rapidly increase organic matter throughout the soil profiles, mitigating the effects of sodium. But the millet would not put enough organic matter into the topsoil to substantially increase its permeability, so the sodium could not be flushed out. It would take at least several hundred years for organic matter to accumulate to as much as 1 foot.

The company has suggested, but not specifically proposed, several other mitigating measures. These include:

- 1) Burial of overburden spoils whose exchangeable sodium percentage (ESP) values exceed 15. This would be the single most effective mitigation the company could employ. If the sodic overburden (which makes up at least 47 percent of the total overburden) were redistributed and not buried, it would probably affect more than half of the replaced topsoil.

- 2) Place a 3- to 4-inch thick layer of coarse rock fragments between the overburden spoil and the replaced "topsoil." This layer would probably not be thick enough to serve as a hydrologic barrier to discourage sodium movement.
- 3) The use of chemical amendments (including gypsum) to neutralize the sodic spoils if deep ripping did not prevent sodium movement into the topsoil. The company would prefer this technique. The use of gypsum would be studied in any case.

Almost all of the sodic overburden is silty clay loam, despite its visual classification as sandstone. Reports of sandstone mineralogy in the area (Hinkley, and others, 1978) show numerous feldspar grains of sand size. The feldspars would weather rapidly, increasing the sodium, calcium, and potassium available for exchange on clays and in the soil solution, and decreasing the proportion of sand-sized grains in the near-surface soils.

Reported ESP values are not necessarily accurate. Carbonate-affected materials are difficult to work with in determining effective cation exchange capacity (CEC) values because of precipitated carbonates on clay faces. In soils and soil materials, the effective CEC is reduced because the exchange sites are covered by uncharged calcium and magnesium carbonates. Treating the material with ammonium acetate to extract exchangeable sodium and determine CEC effectively increases the CEC values by removing carbonates. Increased CEC values would have the effect of decreasing reported ESP levels, and understating the degree of sodicity in the overburden spoils. Hinkley and others (1978) report that "sandstones" in the Hanging Woman Creek area (20 miles east of Spring Creek) contain as much as 80 percent carbonate, much of it as cement coating individual particles.

Reported ESP values indicate lower sodium concentrations in the overburden than reported SAR values. The high SAR values would probably not return to a lower value compatible with the ESP figures. The overburden spoils of concern would be in the near-surface environment, where the partial pressure of CO_2 would be close to that of the atmosphere, thus reducing permanently the solubility of calcium and magnesium carbonates. Exchangeable cations, therefore, would likely come into equilibrium with the calcium- and magnesium-reduced soil solution, not the reverse. Under these circumstances the ESP values would rise to equilibrate with the higher SAR values.

e. Vegetation

About 3,000 acres of existing vegetation would be destroyed over a 25-year period as a result of mining and the construction of support facilities. This is about 30 percent less area than would be affected by the original mine plan. This vegetation, hence the existing vegetation mosaic, would be progressively destroyed during the course of mining. Because of a continuous reclamation program, the largest area disturbed

at any one time would be an estimated 940 acres assuming that in 3 to 4 years following reclamation (4 to 5 years after mining) the land would be suitable as watershed and, to a limited extent, as wildlife habitat.

Communities included in the scrub, grassland, and steppe physiognomic types would be the most impacted because of their extensive distribution within the permit area. Only a few acres of the ponderosa pine/juniper community would be disturbed; however, in view of the ecological requirements of ponderosa pine, this species would probably be lost as a self-sustaining, regenerating population from the mine area for the long-term. The riparian community which occurs almost exclusively along South Fork Spring Creek would not be directly disturbed under this mining plan. It is possible, although company data suggests it is unlikely, that mining might disrupt the ground-water flow in the alluvial aquifer and thereby lower the water table. Should this happen, there would be a significant reduction of the community's vegetative productivity; and, ultimately, the elimination of the deciduous trees and shrubs along the affected portion of South Fork Spring Creek.

Because the company proposes to use only 27 species during reclamation (or about 10 percent of the existing number of species), species diversity following mining and reclamation would be greatly reduced. Not all of the seeded species (only 50-75 percent) are anticipated to become established owing to the interspecific competition among seeded species. Initially reclamation would result in a relatively homogeneous cover of grasses, forbs, and weeds; however, the proposed reclaimed topography and plantings of selected species would facilitate the development of a vegetation mosaic. The development of this mosaic would be a slow process, requiring several decades.

One aspect of the reclamation plan which could lead to the rehandling of once-graded spoils and the possible disruption of already revegetated areas is the proposal to stockpile 11,500,000 bank cubic yards of surplus spoil material in the form of preplanned diverse topography within the rectangular areas shown in figure VIII-11. These surplus spoil materials would be kept in reserve, to fill areas where subsidence occurred. If subsidence did not occur, the surplus spoils would be left undisturbed, and reclamation of the contoured stockpile areas would continue without severe interruption. If, however, subsidence were to become a problem after several years--perhaps late in the mining and reclamation sequence, or following the cessation of mining operations--then "borrowing" fill from these stockpile areas would require the rehandling of spoils, some of which could have become an integral part of a stabilized, successfully-reclaimed area. To disturb such an area would not only destroy whatever vegetation was established, but it would probably decrease the stability of the surface locally.

f. Wildlife

Mining in accordance with the Central Field mine plan would significantly alters the projected impacts of the original mine plan on

some species while other species would be impacted to a similar degree. The result of mining under the alternate plan would cause the loss or disturbance of about 3,000 acres all of which is classified as wildlife habitat. The carrying capacity of the entire permit area would be lowered for individual species which have more specialized requirements currently provided for in the permit area. This alternative would provide more topographic and potentially more vegetative diversity for wildlife than the original mine plan.

1) Antelope

Impacts to antelope would be essentially the same as under the original mine plan (chapter III, Wildlife, Antelope); this is so because the alternate mine plan would not significantly alter the intensity or extent of disturbance to antelope habitat.

2) Mule deer

Impacts to mule deer would be greatly reduced by the alternate mine plan as compared to those forecast under the original mine plan. Although human activity may reduce the utilization of the "major use area" along the bluffs to the south of the mine area, this impact would be completely offset by not disturbing the bluffs. Major north-south and east-west migration routes between "major use areas" and local movement patterns would be blocked by mining activities and the railroad corridor.

3) Other mammals

Small mammal populations would be impacted to the same degree within the mining area as forecast in chapter III, Wildlife, Other mammals. However, the elimination of the southern portion of the original mine area from disturbance would greatly reduce the impacts which otherwise would have been generated.

4) Upland game birds

Mining under the Central Field mine plan would impact sage grouse to a lesser degree than they would be impacted under the original mine plan. Although the alternate mine plan would disturb only a portion of the sage grouse wintering area, this disturbance would effectively reduce the carrying capacity of the wintering area an by unknown amount.

Impacts to other upland game birds would be reduced owing to the reduced acreage disturbance and the increased topographic diversity under the alternate mine plan.

5) Raptors

Impacts to raptors would be greatly reduced from those forecast in chapter III, Wildlife, Raptors. This reduction would result from the

decreased area to be disturbed. Mining would destroy nesting habitat in the central bluffs, displacing raptors which nest in this area. Subregional populations of raptors would be insignificantly lowered as a result of the implementation of this mine plan.

6) Songbirds

Impacts to song birds would be reduced by the reduction in the mining area and the increased topographic diversity. (These impacts would not be significant.)

7) Amphibians and reptiles

Impacts to amphibians would be largely eliminated and the impacts to reptiles would be generally unchanged (chapter III, Wildlife, Amphibians and reptiles).

g. Sociology

Impacts on society from the revised mine plan would not be substantially different than those generated by the original plan. The proposed 7 mty (million-tons-per-year) mine, along with the existing and projected mines in the area, would contribute to an overall lowering of the quality of life for those living in the Birney-Sheridan area. Impacts on social and psychological well-being would be concentrated in the Sheridan urban area, including Sheridan, Dayton, and Ranchester. The reduction in quality of life would result from a continuing breakdown in society, which is already beginning to occur as the result of current mining activities in Sheridan and Big Horn Counties. Impacts from the Spring Creek mine, taken alone, would not be as significant as the cumulative effects of existing, projected and proposed mines.

1) Population

A trend of increasing population in Sheridan County is anticipated from 1979 to 1990, with minor boom and bust cycles related to the construction and opening of mines. There is expected to be little or no population growth in Big Horn County as a result of the proposed Spring Creek mine. The population analysis shows a projection of the current current growth rate (baseline) plus the Spring Creek mine at 7 million tons per year (table VIII-5).

Growth would be concentrated in the Sheridan urban area. Between 1978 and 1990, the urban population would be expected to increase by 45 percent, an increase of about 7,100 people as compared to about 6,300 people (40 percent increase) without the mine. This is about one percent less growth than would be anticipated under the original mine plan. Growth would be rapid from 1978 through 1980 with a sharp decline in 1981 when the annual rate of change would drop from about 5 percent to -0.6 percent. The rate would then increase steadily at about 2.5 percent until 1986, when it would increase to a little over 3 percent. In 1990 there would another period of rapid growth, as the ancillary sector expands to provide services to meet the growth in the primary sector. There would be more

people employed as a result of the 7 mty mine plan than the 10 mty plan if the construction period is limited to 1 year. (See chapter VIII, Economics.) If construction of the mine takes 2 years, as in the original mine plan, employment and population would be the same as in the original plan.

TABLE VIII-5.--Population projections with
addition of Spring Creek mine at 7 million
tons per year

Year	Actual county population	Urban population
1978-----	22,487	15,734
1979-----	22,945	16,192
1980-----	23,739	16,986
1981-----	23,637	16,884
1982-----	24,022	17,269
1983-----	24,441	17,688
1984-----	24,887	18,134
1985-----	25,358	18,605
1986-----	25,931	19,178
1987-----	26,527	19,774
1988-----	27,149	20,396
1989-----	27,791	21,038
1990-----	29,558	22,805

An independent analysis (Thompson and others, 1978) found that growth rates from 5 percent to 9 percent per year could be reached in Sheridan County from proposed and projected mines. The Spring Creek mine would contribute about 10 percent of this growth. Because Sheridan is already undergoing stress, these growth levels could make it hard to prevent community disintegration, including structural disorganization, social anomie, and fiscal bankruptcy (Thompson and others, 1978).

Sheridan and Sheridan County have had difficulty planning for coal-related impacts, due to a lack of commitment or a sense of direction in local government (EPA, 1977). Unless Sheridan implements plans to meet new demands on services and facilities, the quality of life for existing residents will be threatened even if annual growth is less than 5 to 9 percent. (See chapter III, 'Land use, Impact on planning.)

h. Economics

1) Employment and income

The Spring Creek mine would generate additional economic base employment in Big Horn County, at the minesite. In Sheridan County

there would be an increase in the number of railroad employees due to the additional Spring Creek coal traffic. Because of the lack of urban development near the minesite, it is assumed that Spring Creek mine employees would reside in Sheridan County. This, in turn, would cause increases in the number of jobs in the ancillary sector in Sheridan County.

Construction at Spring Creek would commence in 1979, with the establishment of mine facilities, and would be completed in 1980¹. According to the amended mine plan, the peak construction work force would be about 440 workers, 40 fewer than under the original plan. Mining would begin in 1980, before the end of the construction period, and continue for 25 years. The company estimates that it would require approximately 220 employees to produce the proposed 7 million tons of coal per year. This would be about 33 fewer production employees than under the original mine plan.

The net employment effect of the Spring Creek mine would be to increase the number of jobs in Sheridan County by something less than 3 percent of the 1990 baseline. The difference between the original and the revised mine plans is relatively insignificant. (See table III-4.)

The net income effect would be about the same order of magnitude as the employment effect.

2) Fiscal conditions

Fiscal impacts on local governments in Sheridan and Big Horn Counties would be similar to impacts from the original mine plan. Most of the adverse impacts would be in Sheridan County because most of the new people associated with the mine are expected to live there, and because most revenues generated from the mine would go to Montana.

On the other hand, Montana State revenues would increase substantially from the additional taxes generated from the Spring Creek mine (appendix I-2, table E).

a) Sheridan County

Under the revised Spring Creek mine plan, average yearly revenues for Sheridan County from 1978-83 would increase only slightly faster than expenditures (appendix I-2, table K), and per capita town revenue in Sheridan would not change significantly compared with baseline projections (appendix I-2, table F). The ability of local governments in Sheridan County to

¹If, as originally planned, the mine is constructed only during 1980, there would be a population and employment bulge in 1980-81. The maximum net employment effect would be 8.1 percent greater than baseline employment in 1980. The employment effect would gradually decline to a low of 2.6 percent greater than baseline employment in 1990.

finance public services would probably be the same under the revised mine plan and the original plan (compare tables K and L, appendix I-2).

There would be a time lag between the arrival of new mine employees and the receipt of local tax revenues from those who live in Sheridan County. A gap between potential revenues collections and immediate service needs could create shortfalls in the public service sector. School District #1 would be most severely impacted, because it has already reached its maximum allowed bonding capacity and is overcrowded. Community services, already lagging behind demand, would not satisfactorily accommodate even the modest population growth attributable to Spring Creek mine.

b) Big Horn County

The rate of increase in total taxable value, from 1979-84, would be larger than the baseline projections (appendix I-2, table K). After 1984, the rate of increase would be about the same as in the baseline projections. Property taxes from Spring Creek mine would increase the ability of the county to finance its services. The high school and elementary school districts in which the mine is located would have an increased ability to raise funds. Because the minesite is beyond the tax jurisdiction of the town of Hardin, the per capita town revenue of Hardin would not change from the baseline projections (appendix I-2, table F).

Big Horn County would receive less property taxes from the lower-tonnage mine. Since expenditures are the same for both mine plans, the ability for Big Horn County to finance public services would be greater with the 10 mty mine plan. Greater property taxes generated by the 10 mty mine would also make county school districts better off. Neither mine plan would significantly impact the town of Hardin. State revenues would be less with the lower production proposed mine (see appendix I-2, table E).

i. Esthetics

The reconstruction of drainage basins and a moderately irregular surface, under the amended reclamation plan, would lessen the impacts to esthetics anticipated under the initial plan. There still would be an absence of rock outcrops after reclamation, and the surface would be substantially lower than the surrounding area, thus producing the appearance of a broad valley having low hills within it.

j. Cultural resources

The evaluation of impacts on cultural resources under the amended mine plan has not yet been completed. A recent field survey was undertaken, under contract from NERCO, to confirm the number and location of archeological sites reported in previous surveys and to design a plan for the mitigation of sites that would be affected directly by mining. At this writing there are tentatively 30 sites involved.

This number may change slightly as evaluation is continued, but there would be significantly fewer sites affected than the 53 which would be destroyed under the initial mine plan (analyzed in chapter III, Cultural Resources).

None of the area, including South Fork, south of the southern buffer zone would be subject to direct disturbance from mining activities. It can be anticipated, however, that unauthorized collecting and possibly vandalism of sites in this area might occur from people on foot.

Even though the mitigation of cultural resources has not yet been resolved, it should be emphasized that no mining and reclamation permits can be issued until a plan for mitigation has been fully accepted by the Montana Department of State Lands with the concurrence of the Office of Surface Mining, the Montana State Historic Preservation Officer, and the Advisory Council on Historic Preservation.

F. ALTERNATE MITIGATION MEASURES

The following mitigations were included in the draft environmental statement (DES), and were suggested after analysis of the original mine plan. The Central Field mine and reclamation plan is itself a mitigation for many of the impacts generated by the original plan. Many of the alternate mitigations listed in the DES have been accommodated or partly accommodated by the amended plan.

1. Geology

Several technical alternatives exist by which erosion and depostion can be decreased, both during and after mining.

Increased slope erosion adjacent to the proposed stream diversions can be controlled by maintaining gradients of the diversions as nearly as possible to those of the present stream channels. (See Hydrology for related alternatives.)

Erosion of the regraded highwall can be decreased by several methods: regrading the highwall to a slope much less than the legal maximum of 20 degrees (this necessitates either disturbing more surface above the highwall and away from the pit, and requiring the operator to find more spoil with which to backfill); creating either a stepped slope, or some form of a concave upward slope, instead of the proposed straight, regular slope. These methods would diminish slope erosion rates, although by an undeterminable amount.

A variation on the preceding mitigation would be to require the operator to mine southward to the face of the resistant sandstone unit forming the south bluff mentioned in chapter II. The exposed bluff is resistant to erosion, as well as being more natural appearing than a highwall. If used selectively, the method may also free more spoil for use as fill elsewhere.

To diminish the headcutting of ephemeral drainages which would drop abruptly over the regraded higwall, spoil may be backfilled adjacent to those drainages so that a more natural and stable concave upward drainage profile would be attained. In so doing, however, small alluvial fans would form which could, in some instances, allow the transport of sediments as far as the reclaimed main stream channels. It is conceivable that downstream sedimentation could occur subsequent to major runoff events.

2. Hydrology

If it is deemed necessary to restore the shallow (aquifer) water table, this can be done by constructing a water retardant layer of material below the new artificial flood plain of South Fork.

Wells that are destroyed or dried up should be replaced when they are needed for watering livestock upon completion of the mining and reclamation. Some wells may be able to develop water from the resaturated spoils where there is sufficient thickness of saturation. Water from the spoils will probably be high in dissolved solids. Most wells will need to extend to sandstone or to other coal aquifers in the Fort Union Formation below the mined out area, where quality of the water generally improves. A discussion of the changes in quality with depth is given in chapter II. A potentially contributing source of ground water to the spoils is from spoil areas that have not been revegetated. Therefore the primary effort for the prevention of the leaching of spoils should concentrate on the prompt revegetation of the spoil surfaces. Deep, as well as shallow, rooted vegetation is desirable to more completely utilize the soil moisture and to prevent deep recharge of soil water into the spoils.

3. Air Quality

NERCo, in conjunction with the Air Quality Bureau and the Environmental Protection Agency, should design an implementation plan for monitoring the air quality in the Spring Creek area before, during, and after mining operations. Approval of the mining permit application should be contingent upon such as agreement.

The best available technology for the abatement and control of particulate and pollutant gases should be employed. These controls include: (1) enclosing all coal in a storage facility equipped with particulate fabric filters (baghouses); (2) completely enclosing the primary and secondary crushers in facilities equipped with baghouses; (3) completely enclosing all coal conveying systems; (4) installing water sprayers at all conveying transfer points; (5) installing a negative pressure truck dump; and (6) watering and chemically treating all haul roads. These installations would reduce the potential particulate emissions from the mine by 74 percent--from 21,000 tons per year to 5,460 tons per year.

Before loading onto unit-trains, all coal should be treated with a dust suppressant. Hot oil has been used successfully for this

purpose and does not interfere with the combustion properties of the coal.

Temporary topsoil or overburden stockpiles should be stabilized with organic substances such as hydromulch. Stockpiles (topsoil) which will not be used for over a year should be stabilized with vegetation in order to control wind erosion and dust.

4. Soils

a. Management alternatives

The problem of long term impacts and characteristics of the post-mining reclamation surface has been discussed in chapter III. There is a need to assure the full reclamation of the mined surface, which would permit the reintegration of the area into the local patterns of land use. The release of the reclamation bond is presently predicated on vegetative composition and density. A competent reclamation team working with a well developed and executed mine plan should be able to produce a reasonable vegetative stand during the life of the mine and the subsequent bonding period. Unfortunately, under these conditions, species composition and density is not an indicator of landscape stability.

There is a need for special management or use restrictions in the postbonding period which will insure the integrity of the reclaimed surface until it can be demonstrated that the area is as stable as adjacent areas and can be used in the same manner. The duration of such a period is unknown. Estimates may range from decades to centuries.

The means of instituting and enforcing requirements which would effect these goals would undoubtedly be controversial. The means, at this point, however, are relatively unimportant. The importance lies in the fact that the effectiveness of reclamation at Spring Creek, as well as other minesites, has not been demonstrated. There is no assurance that normal land-use patterns for the region can be safely reinstituted a decade after mining.

The mining and reclamation plan originally submitted by the applicant does not address many of the chemical limitations placed on successful reclamation by the characteristics of both the soils and the overburden found on the proposed minesite. There are a number of possible approaches which could be used to enhance the chances of a successful reclamation program. These techniques would be designed to limit the amount of toxic, potentially toxic, or otherwise undesirable material at or near the reclaimed surface.

b. Selective salvage of overburden

There is a significant volume of nonsaline, nonsodic overburden within the Spring Creek permit area, which could be selectively salvaged for placement over less desirable materials. This procedure would provide

a buffer between the relatively thin veneer of "topsoil" material and the sodic overburden. Rooting depths, infiltration rates, and, ultimately, reclamation success would be enhanced.

The following technical alternatives are presented as possible approaches to solutions of the problems posed by sodic overburden at the Spring Creek minesite. Some of them are untried and unproven, and would require study and experimentation to prove or disprove their effectiveness.

An approach to isolating the influence of sodic spoils has been proposed by Dr. Maynard Fosberg, Professor of Soil Science at the University of Idaho (personal communication) which would utilize the soil resource presently considered too saline for salvage purposes. This scheme would employ a triple-life operation in "topsoil" salvage. In the third lift, "C" horizon soil materials with electrical conductivity (EC) values in excess of 6 mmhos/cc would be used as a buffer between the sodic overburden and the nonsodic "topsoil." This would have the advantage of increasing soil depth as much as 2 feet, and diluting any translocated sodium below the hazard ratios. The saline soils are dominated by magnesium and calcium sulfate and bicarbonate.

There is a significant element of risk to this proposal involving the possible translocation of salts from the saline material into the nonsaline "topsoil." However, since the solubility and mobility of calcium and magnesium salts is less than that of sodium, the risk may be less than that of placing "topsoil" directly on sodic overburden. Intensive research plots would be required to test the effectiveness and viability of this approach before widespread use was made of the technique.

Much of the central-bluffs material appears to be basically nonsodic and could be salvaged for spoil-surfacing material. Because the Spring Creek mine would be partly a truck and shovel operation, it would be possible to salvage nonsodic overburden that appears to be associated with the Wasatch Formation, and which overlies the Fort Union Formation and caps the central-bluffs area. The relatively small amounts of sodic overburden would be effectively diluted during handling and redistribution.

c. Detailed soil characterization

During the course of mining, approximately 70 acres per year will be disturbed. This is a relatively small area, and could readily be fully characterized and staked for maximum salvage. Salvage operations should be supervised by reclamation personnel to assure full utilization of available soil resources.

Field checks by State soil scientists indicate that there is somewhat more salvageable "topsoil" material in the central-bluffs area than shown in the original soil survey. Soil survey revisions in progress should correct this situation.

5. Vegetation

a. Fertilizer

Apply fertilizer, if indicated by test results, at time of seeding on areas with slopes greater than 5:1. This would minimize the likelihood of it being blown or washed away (Cook and others, 1974).

Do not apply nitrogen fertilizer to trees or shrubs after July 1. This would prevent excessive late summer growth and encourage proper maturity and hardening (Carlstrom, 1972), thereby minimizing winter injury.

Limit reclamation use of topsoil and non-toxic substrate to material not exceeding 2 ppm molybdenum content. This has been proposed by the Miles City District Office of BLM, after consultation with several State and Federal agencies and institutions, as being the soil suspect level for the element. Excessive molybdenum relative to elemental copper, i.e. a copper-molybdenum ratio of less than 2:1, in forage, can cause molybdenosis in cattle (DePuit and others, 1977).

b. Seedbed preparation

Where rubber-tired tractors are used, reduce tire pressure to the lowest recommended for a given load. Eriksson and others (1974) indicated that this procedure significantly reduces topsoil compaction, thereby allowing greater vegetation production.

Use dual rear wheels on tractors when rubber-tired models are used. This measure would help reduce the pressure of tires on the soil to about 14 lbs/in². Eriksson and others, (1974) have shown that pressures greater than this can create soil compaction problems and impair vegetative growth.

c. Seeding

Use grass seed grown only within 300 miles north or 200 miles south of origin; however, adjustment may be made for elevation (Anonymous, 1977). Furthermore, seed for warm season grasses should be used only from immediately local sources up to 150 miles south.

Seed by drilling a pure live seed (PLS) mixture of 3-5 forb seeds, 2 shrub seeds, and the remainder grass--not to exceed approximately 45 PLS per ft². This mixture would provide a good balance by vegetation class and be suitable for more critical sites such as west and south slopes (Cook and others, 1974), while minimizing interspecific competition.

Drill seed all slopes of 3:1 or less, in lieu of partial broadcasting.

Drill all grass seed to a depth of approximately 1/2 inch. This would be about optimum for average-sized grass seed for maximum germination (Anonymous, 1977; Wambolt, 1976; Cook and others, 1974).

Plant browse species shallow--approximately 1/16- to 1/4-inch deep. This depth is recommended by Cook and others (1974); Deveraux (oral communication, 1977) feels that broadcasting 4-wing saltbush will produce better results.

Use only certified seed. This will insure quality seeds as they must "...meet minimum requirements as to germination and limitations on weed seeds, other crop seeds, and inert matter" (Vallentine, 1971).

Modify seed bins on the drill to include an agitator which will promote uniform seed stands, thereby minimizing interspecific competition, weed competition, and bare spots (Anonymous, 1977).

Inoculate all legume seed with the proper bacteria within 48 hours prior to planting (Anonymous, 1977). Legumes are dependent upon certain bacteria for making nitrogen from the air available for use by the plant. Inoculation of legumes by the proper strain of Rhizobia bacteria can insure natural nitrogen availability in the soil as legumes decompose in the soil (Vallentine, 1971). This available nitrogen would be necessary after that from initial artificial fertilization has been depleted.

Use tubelings for transplanting trees and shrubs. Hodder (1977) suggests the superiority of this method in making deep stored soil moisture more available to the plant roots.

d. Post-seeding management

Implement measures for controlling undesirable insects and rodents. Insects, particularly grasshoppers and harvester ants, and several kinds of small mammals, would very likely destroy an estimated 25-75 percent of new seedlings established through reclamation. Harvester ants have been known to produce barren areas around the ant hills on up to 10 percent of the land area (Vallentine, 1971). This source also documents foraging by the ants up to 100 feet from their nests to collect seeds which are their main diet. Vallentine (1971) documents seedling destruction by some species such as prairie dogs, gophers, mice, rats, voles, and jackrabbits. He further states that jackrabbits often crop off seedling grasses as fast as they emerge. This was a problem particularly in small seeded areas bounded by unimproved range since jackrabbits usually move from unimproved areas to concentrate on new seedlings. Pocket gophers would be a problem since much of their diet consists of roots, rootcrowns, and regenerative organs including rhizomes (Vallentine, 1971).

Prohibit off-road vehicle use on seeded areas until the vegetation is well established.

6. Wildlife

Tree and shrub species valuable to wildlife could be planted on revegetated areas in densities similar to those existing before mining.

Game management areas could be established on reclaimed lands or other Spring Creek Coal Company lands adjacent to the mining area.

Human activity in areas not being mined could be kept to a minimum to reduce wildlife disturbance.

Variances to the State of Montana Reclamation laws could be sought to the benefit of wildlife, i.e. retaining highwalls and water bodies.

7. Social and Economic

The State of Montana (based on the authority of the mine permit) could force the NERCO operation to time their construction such that the impacts of this mine were timely relative to other construction and mining activity. This could decrease the total demand for construction workers in the area. The State of Montana, however, has no incentive to develop such a policy because the major socioeconomic impacts are being felt in Wyoming, not Montana. The State of Wyoming has no control over the decision to permit this Montana mine. Local authorities can only govern as the impacts occur.

The State of Montana Coal Severance Tax could help alleviate problems in Montana but not in Wyoming. Communities that qualify could utilize such funds to solve impact problems. The Montana Coal Board (appointed by the Governor) disperses such funds in the form of loans and grants. Previous rulings by the Attorney General of the State of Montana specify that such funds cannot be used on Indian reservations. If that use were allowed, greater mitigation would be possible because of the sizeable Indian population in Big Horn and Rosebud Counties.

Another possible State mitigating factor is that the State of Wyoming has an Industrial Siting Act (initiated by the Wyoming State Legislature) under which the State Siting Board permits or disallows industrial sites to locate. Pacific Power & Light, the parent company of NERCO, has shown great interest in locating an electrical generating plant in Sheridan County at Prairie Dog Creek. If the Wyoming State Siting Board did not allow this plant to locate, less impact would occur to the local area.

The State of Wyoming established the Wyoming Community Development Housing Authority in 1975. The purpose of this authority is to enable impacted communities to borrow funds over the long term for public works projects as well as public housing. Because the State of Wyoming has a ceiling on the maximum mill levy allowed any municipality, these funds provide new forms of immediate purchasing power for impacted communities. The City of Sheridan could use this to solve various problems.

a. County mitigation

City-county planning does exist in Sheridan County, Wyoming, as does county planning in Big Horn County. Such bodies may regulate and influence land use policies in specific impacted areas, as well as establish preplanning which is essential to impacted areas. These entities could be major tools used in mitigation.

Improvement of public roads and bridges, as well as establishment of a grade separation on Highway FAS 314 in Big Horn County, might help solve some of the congestion which is occurring and would continue to occur with the new Spring Creek mine.

For any impacts that do occur in Big Horn County, (although expected to be sizeably less than those predicted for Sheridan County, Wyoming) surplus property taxes should be available to solve many of the particular problems that may evolve. If a corporate town were established on the Montana side, these surpluses may not be as substantial. The school districts within Big Horn County should be allocated additional funds based upon increased assessed valuations of property. If the impact of new students remains on the Wyoming side, these school districts should have few problems and, in fact, should improve their budget situation.

Sheridan Junior College, located in Sheridan, is a two-year institution which might be used to train technicians for coal mining and related developments. Such training could enhance the college's status as an academic institution. An energy program has already been established to train individuals in coal-related activities.

Cities in Wyoming may use special property assessments, levied on their residences, to retire bonds in lieu of contributions for specific public facilities. New subdivisions could pay out additional property taxes to finance street, water, and other public works.

b. Corporate mitigation

If NERCO commits itself to hiring local labor, and if the local labor force is suitable, the immigration of workers and the demands on housing and public facilities would decrease.

The Wyoming/Montana Industrial Association, a non-profit organization, includes those coal development corporations which have formed an association to "assist communities where industry can assist them."¹ Commitment by this organization could aid in solving impact problems.

c. Federal assistance

Federal assistance is available for specific service categories in areas impacted by energy development. The U.S. Department of Energy (DOE)

¹The Sheridan Press, September 21, 1977.

has compiled a list of these categories relative to assistance available. This list is on file at the Environmental Impact Analysis Program Office of the U.S. Geological Survey, Box 25046, Mail Stop 701, Denver Federal Center, Denver, Colorado 80225.

Additional impact-assistance legislation is pending in Congress.

8. Community services

There are a variety of technical alternatives for providing water, sewer, and other public services. An option which could be applied to nearly every type of public service is the consolidataion or unification of districts. This would provide a larger tax base to support government, and would allow public services to be rendered at a more optimum scale. Commonly there is local political resistance to consolidation because it is seen as a loss of direct control. For this reason, some consolidation that would result in more efficient operations is not implemented.

Some of the most important alternatives which need exploring are ways to get sufficient funding where it is needed, when it is needed, and at the same time preserve equity and prevent over-capitalization.

Several common schemes are applicable to this situation: prepayment of taxes, intergovernmental tax sharing, and state funding mechanisms. Corporate prepayment of taxes has been used in several instances; however, in Montana, corporations feel that the 30-percent severance tax should pay for all impact mitigation, and the State is reluctant to do anything further. It is also true that for a given corporate expenditure, local governments get twice as much revenue from production, or severance taxes, as from prepaid taxes. This is due to the nature of Federal tax codes under which prepaid taxes become capital investment and are depreciated; therefore, companies are more willing to have money taken from production. There is also a problem with the spatial distribution of impact. It may be difficult to allocate prepaid taxes to the governmental entities which will actually experience the impact.

Another alternative solution is intergovernmental tax sharing, which avoids some of the problems of the first solution. Wyoming has a Joint Powers Act, and Montana has the Interlocal Agreement Act, both of which allow local governmental entities to join together for specific tasks. This is often used for joint planning programs or construction of a joint facility. It is very unlikely, however, that this method would be used to funnel money from the tax base to the impact area. Such tax sharing would almost have to be imposed by the state to overcome local political problems. Even so, the state line would still be a barrier to the flow of funds.

Either of these systems or modifications of them could provide adequate service within a state. Neither can address multi-state issues. At this point, only the Federal government can provide the necessary assistance. This could be done by redistribution of Federal severance taxes, similar to the Montana system, or by raising and distributing money as in the Wyoming system.

NERCO has made plans to establish a construction camp near Decker, Montana (June 1978). The creation of this camp would reduce pressures on Sheridan County, Wyoming. Montana would benefit by retaining at least some of the purchasing power of the workers; Big Horn County would receive additional property taxes from the camp. During the construction phase of the Spring Creek mine, some of the construction workers' children would undoubtedly attend the elementary school at Decker. The increased students could stress what is a very small one-room school. High school age children would commute to school in Sheridan, Wyoming.

An alternative which would have a major effect on all community services throughout the region is a planned new town, to be named Spring Creek, near Decker. The current proposal is being developed by a private consortium which has acquired land on the west side of Tongue River Reservoir. The promoters plan to install water and sewer, streets, and a temporary school in the initial phase. The complete array of public services and facilities would eventually be needed to support a population that could reach 3,000 by the late 1980's.

In May 1978 the plan was presented at a public meeting at Decker, Montana. An environmental impact assessment was prepared by the engineering and environmental planners¹ for review by the Big Horn County Planning Commission, and the county has expressed general approval. Additional approval will be required from the Montana Department of Health and Environmental Sciences before the construction of any water or sewer facilities can be undertaken (Tom Ellerhoff, DHES, oral communication, 1979).

The detailed benefits and adverse impacts of the town cannot be specified at this time. If the promoters can develop the town into an attractive, well designed, well rounded community, it could have numerous benefits. The impacts could be at least partially contained within Montana where they are generated and where severance tax funds are available to help mitigate them. If the housing could be made affordable, it would greatly reduce the strains on the area's housing market by reducing demand, raising vacancy rates, and slowing the rise in prices.

9. Transportation

A possible alternative to rail transport of coal is through utilization of a slurry pipeline. Such a system is presently proposed from Northeastern Wyoming to a terminus in Arkansas. Furthermore, a recently published proposal to slurry coal from the Sheridan area to Texas² serves to empha-

¹"Spring Creek Environmental Impact Assessment - a new community: quality, environment, and economy," engineering and design by Sanderson-Stewart-Mueller, environmental planning and design by Cumin Associates.

²The Sheridan Press, January 18, 1979, "Public hearing Tuesday-- area water to slurry coal to Texas?"

size the growing pressures that are being applied by some industries to increase public awareness and to influence governmental agencies in favor of the use of slurry pipelines as a viable alternative.

Development of a slurry transport system will require the acquisition of a right-of-way 50 to 100 feet wide and constituting approximately 6 to 12 acres per mile.¹ Authority for condemnation of right-of-way under Federal law is being sought by slurry line interests but has not as yet been granted by Congress.

Large amounts of materials, capital, and labor would be necessary to construct a slurry transport system and the operation of a slurry system under established technology requires large amounts of water to be mixed with the pulverized coal.² It should be noted that present Montana law explicitly excludes the use of water in slurry transport of coal from the list of recognized beneficial water uses.

Reports conflict as to the relative energy efficiencies of rail and slurry lines, and economic operation apparently requires a large diameter, large volume line (20 to 25 million tons per year). The output of Spring Creek mine would not support a major long-distance slurry line although it might contribute, along with output from other area mines, to the operation of such a facility.

Pipeline transport would mitigate some of the adverse impacts of rail movements. Conflicts caused by the crossing of different modes of transportation can be resolved at the design and construction stage thus reducing delays and the potential for accidents. With coal moving under cover and underground, dust and noise impacts should be vastly reduced. Dumping the contents of a line segment as a result of operational failure could produce massive but localized coal contamination.

10. Recreation

It is recommended that the mining company develop additional recreational facilities at the Tongue River Reservoir, as a mitigation of impacts to recreational facilities caused by increased use by Spring Creek employees.

The construction of additional recreation facilities in the proposed new town of Spring Creek would relieve some of the user pressures on the recreation facilities in Sheridan.

¹Mitre Corporation, Resource and Land Investigation (An Approach to Environmental Assessment with Application to Western Coal Development), August 1975, p. VIII-2.

²Energy Transportation Systems, Inc., estimates that 15,000 acre-feet of water would be needed to move 25 million tons of coal through their proposed line to Arkansas.

11. Esthetics

An alternative for reduction of visual impacts would include the painting of buildings, equipment, etc., with neutral colors which blend with the surroundings.

CHAPTER IX

CONSULTATION AND COORDINATION WITH OTHERS

A. PREPARATION OF THE DOCUMENT

This environmental impact statement covers an operation that is but one of the developments of coal resources in the northern Powder River coal basin of Montana. Instructions to prepare the statement were issued to the Geological Survey and the Bureau of Land Management by the Secretary of the Interior on April 29, 1976, designating the GS lead agency. Because of some duplicate or closely related actions pending before Federal and State agencies, and because of the similar requirements of the National and Montana environmental policy acts, the State of Montana joined with the Federal task force in August 1976, in the preparation of this environmental statement. The State task force personnel were under the administrative supervision of a State coordinator attached to office of the Commissioner of the Department of State Lands.

Information was gathered and analyzed by the joint Federal and State task force. Archeological reconnaissance of the lease was performed under contract by Anthropologos Research International, Inc. of Livingston, Montana to supplement the data provided in NERCO's mining application submitted to the State. Major inputs were provided by the Montana Departments of Natural Resources and Conservation; Highways; Health and Environmental Sciences; and Fish and Game; Montana State University, Department of Agricultural Economics; and University of Montana, Department of Environmental Studies. Input was also provided by the Sheridan County, Wyoming, Board of Commissioners, the Sheridan Area Planning Agency (SAPA), and the Sheridan County Planning Commission. A report on social conditions and projected social impacts in Sheridan County that would result from the Spring Creek mine was prepared for the task force under contract by the Center for Urban and Regional Analysis, University of Wyoming.

Other Federal and State agencies providing consultation to the preparation of this statement include the following:

Federal agencies

Bureau of Mines
U.S. Forest Service
U.S. Fish and Wildlife Service
U.S. Environmental Protection Agency
Bureau of Indian Affairs
Bonneville Power Administration

State agencies

Montana Bureau of Mines and Geology
Montana Energy Advisory Council
Montana Department of Community Affairs
Montana Historical Society

Additional participation and assistance were obtained from many sources. The Spring Creek Coal Co. provided data and information on their proposed activities and greatly facilitated field observations and data collection by task force members.

B. REVIEW OF THE DOCUMENT

Public notice was given in the Federal Register on August 31, 1976 that an environmental impact statement was to be prepared on the Northern Powder River coal basin of Montana, which includes the proposed Spring Creek mine. Public notice of the publication and availability of the site-specific draft environmental statement (DES) was given in the Federal Register on August 8, 1978, and was publicized by the local news media. The draft (DES 78-30) was filed with the U.S. Environmental Protection Agency and with the Montana Environmental Quality Council on August 11, 1978.

Public hearings on the draft statement were held at the Big Horn County Shop in Decker, Montana, on September 20, 1978 at 1:30 p.m. and 7:00 p.m. and at the Sheridan Center Motor Inn, Sheridan, Wyoming, on September 21, 1978 at 1:30 p.m. and 7:00 p.m..

The comment period on the draft statement began after it had been filed with EPA and ended on October 13, 1978. In accordance with the CEQ guidelines, copies of the draft statement were made available to the public for inspection and review at appropriate Federal and State offices, as announced in the Notice of Availability in the Federal Register at the time the document was released. The draft environmental statement was and the final will be available for public review at the following places:

U.S. Geological Survey Public Inquiries Office, Room 1012, Federal Building,
1961 Stout Street, Denver, CO 80202

U.S. Geological Survey Library, 1526 Cole Blvd., Golden, CO 80401

U.S. Geological Survey Library, Room 4A100, USGS National Center, 12201
Sunrise Valley Drive; Reston, VA 22092

Montana Department of State Lands, 1625 11th Ave., Helena, MT 59601

Bureau of Land Management, P.O. Box 940, Miles City, MT 59301

Parmley Billings Public Library, 510 North Broadway, Billings, MT 59101

Sheridan County Fulmer Public Library, 320 North Brooks, Sheridan,
WY 82801

Big Horn County Public Library, 419 North Custer Ave., Hardin, MT 59034

The Montana State Library, State of Montana, 930 East Lyndale, Helena,
MT 59601

The Rosebud County Library, 201 North 9th Ave., Forsyth, MT 59327

A single copy of the FES can be ordered by mail from the U.S.
Geological Survey, Box 25046, Stop 701, Denver Federal Center, Denver,

CO 80225; the Montana Department of State Lands, 1625 11th Ave., Helena, MT 59601; and the Northern Powder River Basin EIS Task Force, P.O. Box 1135, Billings, MT 59103.

The following agencies, organizations, and individuals were among those to whom copies of the DES were mailed. Written comments were received from those identified by letter number. Page references are also shown for those letters in the following section on written comments and responses.

Federal agencies

Advisory Council on Historic Preservation*
 Federal Energy Regulatory Commission*
 Interstate Commerce Commission
 U.S. Department of Agriculture
 Forest Service*
 Soil Conservation Service*
 U.S. Department of the Army; Corps of Engineers*
 U.S. Department of Energy
 U.S. Department of Health, Education, and Welfare*
 U.S. Department of Housing and Urban Development*
 U.S. Department of the Interior
 Bureau of Indian Affairs*
 Bureau of Mines*
 Bureau of Reclamation*
 Fish and Wildlife Service*
 Heritage Conservation and Recreation Service*
 National Park Service*
 Office of Surface Mining*
 U.S. Department of Labor
 Mine Safety and Health Administration
 U.S. Department of Transportation
 U.S. Environmental Protection Agency

State and local agencies

Montana Bureau of Mines and Geology
 Montana Department of Agriculture; Pesticide Division*
 Montana Department of Community Affairs*
 Montana Department of Fish and Game*
 Montana Department of Environmental Sciences
 Air Quality Bureau*
 Food and Consumer Safety Bureau*
 Montana Department of Natural Resources
 Montana Environmental Quality Council*
 Montana Historical Society*
 Office of the Governor of Montana
 Office of the Governor of Wyoming

Sheridan Area Planning Agency
Sheridan County Commissioners
Sheridan County Planning Commission
Rosebud County Planning Director
Wyoming State Highway Department*

Applicant

Northern Energy Resources Company,*
on behalf of Spring Creek Coal Company

Other organizations

ASARCO Incorporated*
Burlington Northern Railroad*
City of Gillette*
Milwaukee Railroad
Montana State University
Mountain Bell Telephone Company
Northern Cheyenne Research Project*
Northern Plains Resource Council
Old West Regional Commission
Powder River Basin Resource Council
Range Telephone Cooperative
Sheridan-Johnson Rural Electric Association
Sierra Club
Tongue River Electric Cooperative
Tri-County Ranchers Association*
University of Montana
VTN, Inc.
Yellowstone-Tongue Area Wide Planning Organization

A summary of public hearing comments and responses follows the section on written comments. All substantive comments received have been considered in preparing this final environmental statement.

Written comments and comments received at the public hearings have been considered and incorporated into the final statement as appropriate. Text revisions made in response to comments are underlined in chapters I-VII. Letters received during the comment period, along with task force responses, are printed in the following pages, as indicated below. A summary of the principal comments received at the public hearings and task force responses are contained in a section following the letters.

C. COMMENT LETTERS AND RESPONSES

Federal Agencies	<u>Letter No.</u>	<u>Page</u>
Advisory Council on Historic Preservation-----	1	IX-7
Federal Energy Regulatory Commission-----	2	IX-8
U.S. Department of Agriculture:		
Forest Service-----	3	IX-9
Soil Conservation Service-----	4	IX-11
U.S. Department of the Army; Corps of Engineers-----	5	IX-12
U.S. Department of Health, Education, and Welfare-----	6	IX-14
U.S. Department of Housing and Urban Development-----	7	IX-15
U.S. Department of the Interior:		
Bureau of Indian Affairs-----	8	IX-16
Bureau of Mines-----	9	IX-18
Bureau of Reclamation-----	10	IX-21
Fish and Wildlife Service-----	11	IX-22
Heritage Conservation and Recreation Service-----	12	IX-24
National Park Service-----	13	IX-26
Office of Surface Mining-----	14	IX-27

State and Local Agencies

Montana Department of Agriculture; Pesticide Division---	15	IX-31
Montana Department of Community Affairs-----	16	IX-32
Montana Department of Fish and Game-----	17	IX-42
Montana Department of Environmental Sciences:		
Air Quality Bureau-----	18	IX-44
Food and Consumer Safety Bureau-----	19	IX-47
Montana Environmental Quality Council-----	20	IX-64
Montana Historical Society-----	21	IX-66
Wyoming State Highway Department-----	22	IX-67

Applicant

Northern Energy Resources Company, on behalf of Spring Creek Coal Company-----	23	IX-69
---	----	-------

Other Organizations and Individuals

ASARCO Incorporated-----	24	IX-113
Burlington Northern Railroad-----	25	IX-114
City of Gillette-----	26	IX-121

	<u>Letter No.</u>	<u>Page</u>
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Other Organizations and Individuals--Continued

Northern Cheyenne Research Project:

Elin Quigley and Charles Andrews-----	27	IX-123
James P. Boggs-----	28	IX-124
Tri-County Ranchers Association-----	29	IX-130
Charles VanHook-----	30	IX-138
Dwayne Ward-----	31	IX-141
NERCO, response to comments-----	32	IX-146

A summary of public hearing comments and responses follows the section on written comments, starting on page IX-149.

LETTER 1

Advisory Council on
Historic Preservation
1522 K Street, N.W.
Washington, D.C. 20005

September 8, 1978

Director
U.S. Geological Survey
National Center
Mail Stop 108
Reston, Virginia 22092

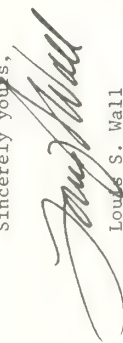
Dear Sir:

This is in response to U.S. Geological Survey's request for comments on the draft environmental statement (DES) for the proposed mining and reclamation plan for the Spring Creek Mine, Big Horn County, Montana. We have reviewed the DES and note that the undertaking may affect sixteen cultural resource sites that have been determined to be eligible for inclusion in the National Register of Historic Places.

Pursuant to Section 106 of the National Historic Preservation Act of 1966 (16 U.S.C. 470f, as amended, 90 Stat. 1320) Federal agencies must, prior to the approval of the expenditure of any Federal funds or prior to the granting of any license, permit, or other approval for an undertaking, afford the Council an opportunity to comment on the effect of the undertaking upon properties included in or eligible for inclusion in the National Register.

Until the requirements of Section 106 are met, the Council considers the DES incomplete in its treatment of historical, archeological, architectural and cultural resources. To remedy this deficiency, the Council will provide, in accordance with its "Procedures for the Protection of Historic and Cultural Properties" (36 CFR Part 800), substantive comments on the effect of the undertaking on these properties. Please call Brit Allan Storey at (303) 234-4946, an FTS number, to assist you in completing this process.

Sincerely yours,



Louis S. Wall
Assistant Director, Office of
Review and Compliance, Denver

Action is currently being taken by the Bureau of Land Management, the Office of Surface Mining, the State Historic Preservation Officer, Montana Department of State Lands, and the company to insure that all requirements of Section 106 of the National Historic Preservation Act of 1966 and Executive Order 11593 are complied with regarding cultural resources within the Spring Creek permit area (appendix A). The mining and reclamation plan will not be approved by Federal and State regulatory authorities until the Section 106 process has been completed.

FEDERAL ENERGY REGULATORY COMMISSION

XXXXXXXXXXXXXXXXXXXX

Federal Building, Room 3130
230 South Dearborn Street
Chicago, Illinois 60604

September 1, 1978

Director
U. S. Geological Survey
National Center
Mail Stop 108
Reston, Virginia 22092

Dear Sir:

We have reviewed the Draft Environmental Statement titled Proposed Mining and Reclamation Plan, Spring Creek Mine, Big Horn County, Montana covering the opening of a new coal mine and associated facilities.

Comments of this office are made in accordance with the National Environmental Policy Act of 1969 and the August 1, 1973 Guidelines of the Council on Environmental Quality. Our principal concern with developments affecting land and water resources is the possible effect of such developments on bulk and electric power facilities including potential hydroelectric developments and on natural gas pipeline facilities.

Because the above noted proposed development would not pose a major obstacle to the construction or operation of such facilities and because the Draft does not indicate that natural gas or electric utilities would be adversely affected, we have no specific comments. We would note, however, that low sulfur coal of the type that would be produced by the proposed new mine is being sought by electric utilities as an environmentally acceptable fuel for their electric generating plants.

These comments are of this office and, therefore, do not necessarily represent the views of the Federal Energy Regulatory Commission.

Thank you for the opportunity to comment on this Draft Environmental Statement.

Very truly yours,

Bernard D. Murphy

Bernard D. Murphy
Regional Engineer

Your comments have been noted.

UNITED STATES DEPARTMENT OF AGRICULTURE

FOREST SERVICE

P. O. Box 7669, Missoula, MT 59807

LETTER 3

1950



Director
U. S. Geological Survey
National Center, Mail Stop 108
Reston, VA 22092

Dear Sir:

We have reviewed the Draft Environmental Statement for the Proposed Mining and Reclamation Plan, Spring Creek Mine, Big Horn County, Montana.

The proposed project has no direct effect on National Forest lands located approximately 20 miles to the north and east. Indirectly, additional recreational demands can be anticipated from the work force involved, and we have considered such an impact in the land management plan for that area.

We are including the following general comments for your consideration:

The overall organization of the document and the display of information appear adequate to assess the impacts of the proposal, both favorable and unfavorable. A disturbing factor, which we have detected throughout that portion of the statement beginning with Chapter III, is the apparent bias against the proposal. Some examples may help clarify this impression.

A Land Use Objectives. Present use of the area centers around grazing, wildlife habitat, and water. Restoration to these same uses is proposed following mining. (Page III-33) Considering there will be at least some degree of success at restoration, the question of how big an issue land use is compared to the magnitude of coal recovered should be raised. In reading the comments, especially on wildlife, land use becomes a major issue and all comments are negative, giving the entire document a negative flavor.

B Land Form. (Page III-1) Apparently, the decision has been reached that the gently sloping 3-mile plane is the only

A Although the company proposed to return the entire area to its present kinds of uses under the original mining and reclamation plan submitted, little recognition was afforded wildlife values in that reclamation plan. Therefore, the analysis of impacts to wildlife appears to be more negative than would the analysis of a reclamation plan which is more directed at wildlife values.

B The initial company proposal provided for a recontoured surface with a gently sloping profile because of the lack of sufficient overburden to create a diverse topography and still maintain stream gradients. No such alternatives exist under the original mine plan without the importation of additional fill material. Alternative landforms are possible under the "Central Field Mine Plan" discussed in chapter VIII.

LETTER 3

-2-

possible landform. This again sets up a negative reaction, giving the report a negative flavor. Alternative landforms should be addressed.

⁴
C Recreation Impacts. (Page III-40) Although recreation impacts are not quantified, the report assumes there will be overuse. One purpose of an EIS is to determine impact magnitude, as compared with existing use. Then a judgment can be made as to overuse and possible mitigation.

We appreciate the opportunity to comment on the Draft.

Sincerely,

for James E. Paul
ROBERT H. TORHEIM
Regional Forester

cc: RF
Custer
WO-P&L

C In the section on recreation in chapter III the impact statement does not state that the population increase (918 people) due to the Spring Creek mine would result in overuse of recreational facilities. Rather, the statement suggests that the cumulative recreation impacts of this and other future developments would lead to overuse of some, but not all, existing facilities. If the recreational use of all facilities is proportional to the population growth, a 4 percent increase in use may be attributable to the Spring Creek mine.

Current specific use data are not available. The local populace considers most facilities to be inadequate, or barely adequate only for the existing population.

LETTER 4

UNITED STATES DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

P. O. Box 970, Bozeman, Montana 59715

October 13, 1978

Director, U. S. Geological Survey
National Center
Mail Stop 108
Reston, VA 22092

Gentlemen:

We acknowledge receipt of the draft environmental statement for the "Proposed Mining and Reclamation Plan, Spring Creek Mine" in Big Horn County, Montana, that was addressed to the Coordinator, Environmental Quality Activities, U.S. Department of Agriculture, Attn: Soil Conservation Service, Washington, D. C. 20250 on August 9, 1978, for review and comment.

We have reviewed the above draft environmental statement and find that there are no items in the statement within the realm of the Soil Conservation Service's expertise and responsibilities that have not been addressed by the Montana Department of State Lands. We find no conflict with any SCS on-going or planned programs or projects.

We appreciate the opportunity to review and comment on this proposed project.

Sincerely,


Van K. Haderlie
For State Conservationist

cc: Shiftlet, SCS, Washington, D.C.

Your comments have been noted.





DEPARTMENT OF THE ARMY
OMAHA DISTRICT CORPS OF ENGINEERS
6014 U S POST OFFICE AND COURTHOUSE
OMAHA NEBRASKA 68102

LETTER 5

MRPOD-M

7 September 1978

Mr. H. William Menard, Director
U.S. Geological Survey
National Center, Mail Stop 108
Reston, VA 22092

Dear Mr. Menard:

This is in response to your notice in which you transmitted a copy of the Draft Environmental Statement (Proposed Mining & Reclamation Plan) for Spring Creek Mine, Big Horn County, Montana.

Based on the information submitted, the proposed activity will not involve the filling of a wetland area and is located on creeks which have an average annual flow of less than 5 cubic feet per second. Therefore, in accordance with the Final Regulations as published in the Federal Register, Volume 42, No. 138 of Tuesday 19 July 1977, your proposed projects are permitted under the "Nationwide Permit" provided the following are adhered to:

- a. That the fill will not destroy a threatened or endangered species as identified under the Endangered Species Act or endanger the critical habitat of such species.
 - b. That the fill will consist of suitable material free from toxic pollutants in other than trace quantities.
 - c. That the fill created by the discharge will be properly maintained to prevent erosion and other non-point sources of pollution.
- In addition to the conditions specified above, the following management practices should be followed to the maximum extent practicable in the performance of the work:
- a. The placement of fill in spawning areas during spawning seasons should be avoided.

Your comments have been noted.

LETTER 5

7 September 1978

MROPD-M

Mr. H. William Menard, Director

b. The fill should not restrict or disrupt the movement of aquatic species indigenous to the waters or the passage of normal or expected high flows or cause the relocation of the waters (unless the primary purpose of the fill is to impound waters).

c. If the fill creates an impoundment of water, adverse impacts on the aquatic system caused by the accelerated passage of water and/or the restriction of its flow should be minimized.

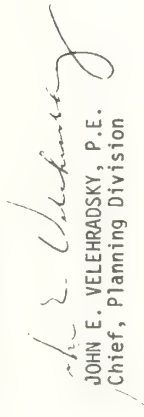
d. Fill in wetlands areas should be avoided.

e. Heavy equipment working in wetlands should be placed on mats.

It does not appear that any of the proposed measures would impact adversely on any planned or existing Corps of Engineers activities in the areas of concern.

We appreciate having had the opportunity to review this document. Please furnish this office a copy of the final EIS when it is available.

Sincerely yours,


JOHN E. VELEHRADSKY, P.E.
Chief, Planning Division

LETTER 6

DEPARTMENT OF HEALTH, EDUCATION AND WELFARE



Mr. William Menard
Director
Geological Survey
U. S. Dept. of the Interior
Reston, Virginia 22092


Dear Mr. Menard:

This will acknowledge receipt of your Draft Environmental Statement on the proposed mining and reclamation plan you have submitted for the Spring Creek Mine in Big Horn County, Montana.

We believe you have adequately addressed all aspects of the impacts expected to result from the proposed development.

Your comments have been noted.

Sincerely yours,


Thomas E. Moore, P.E.
Director, ROFEC
Regional Environmental Officer



DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT

REGIONAL OFFICE
EXECUTIVE TOWER 1405 CLUPTIS STREET
DENVER, COLORADO 80202

LETTER 7

REGION VIII

October 10, 1978

850Q

Mr. H. William Menard
Director
U.S. Geological Survey
National Center, Mail Stop 108
Reston, Virginia 22092

Dear Mr. Menard:

Thank you for the opportunity to review the draft Environmental Impact Statement (EIS), "Proposed Mining and Reclamation Plan, Spring Creek Mine," Big Horn County, Montana.

Your draft EIS has been reviewed with specific consideration for the areas of responsibility assigned to the Department of Housing and Urban Development (HUD) for review of other agencies' EIS's. These areas focus on a proposal's compatibility with local and regional comprehensive planning and impacts on urbanized areas.

A The relationship of this project to local and regional planning, if any, was not clearly delineated in terms of how it will impact such plans. Some indication of the degree of support or interest in this undertaking by local officials and organizations, as well as public opinion, should be included. Otherwise, our review indicates that you have adequately addressed those areas of responsibility assigned to HUD by the Council on Environmental Quality.

We appreciate the opportunity to review and comment on this draft EIS. If you have any questions regarding these comments, please contact Mr. Walter O. Kelm, Regional Environmental Clearance Officer, at (303) 837-3102 or FTS 327-3102.

Sincerely,

Raymond D. McKinney
Raymond D. McKinney
Director

Program Planning and Evaluation

A See text revision, chapter III, Land Uses, Impact on Planning.
A See also letter #16.



IN REPLY REFER TO
Environmental Quality

United States Department of the Interior

BUREAU OF INDIAN AFFAIRS

BILLINGS AREA OFFICE
316 NORTH 26TH ST
BILLINGS MONTANA 59101

LETTER 8

Memorandum

To: Director
U.S. Geological Survey
National Center, Mail Stop 108
Reston, Virginia 22092

From: Office of the Area Director

Subject: Draft Environmental Statement, Proposed Surface Coal Mining Operation, Spring Creek Mine, Northern Energy Resources Company, Big Horn County, Montana (DES 78/30)

This office has reviewed the subject statement and wish to submit the following comments:

- A** Page 1-13 discusses disturbance to surface and ground water from removal of the Canyon seam. We believe it to be appropriate to discuss here and in other sections that the ground and surface water are concerns of both the Crow and Northern Cheyenne Tribes. Both tribes are involved in water litigation with Wyoming and Montana, and are concerned with any action that seeks to degrade quality, or reduce quantity of surface or subsurface waters to which they are entitled.
- B** Page 1-14, Table 1-2. Coal trace element analysis. The text does not discuss whether the analyses are normal or present hazards. We are especially concerned that the proximity of the Tongue River Reservoir to mining activity may cause degradation of water quality.
- C** Page 1-17. Railroad and powerline. The text should discuss how much new trackage will be required.
- C** Page 1-40. Mitigating measures. We agree that the company will probably have to obtain a preconstruction permit from EPA demonstrating compliance with the Northern Cheyenne Indian Reservation Class 1 PSD requirements.
- D** Page II-15. Temperature. The text states that "Daily temperatures may be expected to range from -130° F in winter, to 100° F in summer". Daily temperatures in winter may well exceed -130° F. A publication entitled "Climate and Man" shows maximum and minimum temperatures at Crow Agency to be +110° F and -50° F.

A It is considered that disturbance of ground- and surface-water systems at the Spring Creek site will have no measurable effect on the quantity or quality of the water on the Northern Cheyenne or Crow Reservations.

B See text revision, chapter I, Background and History, Description of the Coal Resource, and chapter III, Surface Water.

C See text revision, chapter I, Proposals of the Spring Creek Coal Co., Construction of Facilities, Railroad and Powerline.

D Temperature data discussed in this paragraph are from a weather monitoring station within the permit area and represent only 1 year's data. See text revision, chapter II, Climate, Subregional Climatic Factors, Temperature.

E 6. The entire soils section is difficult, if not impossible, to review due to the fact that the soils are not in the National Cooperative Soil Survey Manual. The Soil Conservation Service has published a Big Horn County Soil Inventory and more recently mapped the Northern Cheyenne Reservation. We believe the range of soil characteristics in the Spring Creek area would be compatible with work already done. An example of morphology discrepancies is that the Colbar series would appear to correlate closely to the Lonna (SCS series) except that Colbar is Borollic. Other taxonomic criteria are not compatible with previous work.

F 7. Page 11-95. Only Shell Oil holds a coal lease on the Crow Reservation proper. Gulf Mineral Resources and Peabody Coal Company hold prospecting permits with an option to lease. The only production in the "ceded area" is from Westmoreland who is currently producing coal from within Tract III, a lease encompassing approximately 14,745 acres.

G 8. Page 11-95. The ownership and/or control controversy was between the Tribe and the allottees. The 1976 Supreme Court case settled this disagreement in favor of the Tribe. The word "Furthermore" should be deleted in the fourth line of the first paragraph.

9. Page VIII-21, Paragraph 3. It appears that the SCS should be consulted on the "alluvial valley floor" question.

10. Page VIII-40. The fall feeding of certain vegetation such as Green Needle Grass is also effective in insuring that revegetation is successful.

David W. Vance
Acting Area Director

E The point is well taken that existing soil series in the National Cooperative Soil Survey would be used by mining companies and their consultants whenever possible. Further, the same taxonomic criteria should be applied when no existing soil series are suitable, and new ones have to be described. At the present time, this is not a requirement, but it is presently being considered by the Montana Department of State Lands for inclusion in the State Guidelines.

F See text revision, chapter II, Cultural Resources, Historical Overview, Big Horn and Sheridan Counties, Crow Indians.

G See text revision, chapter II, Cultural Resources, Historical Overview, Big Horn and Sheridan Counties, Northern Cheyenne Indians.



United States Department of the Interior

BUREAU OF MINES
2401 E STREET, NW
WASHINGTON, D.C. 20241

LETTER 9

Memorandum

October 10, 1978

To: Director, Geological Survey

From: Director, Bureau of Mines

Subject: Draft environmental statement, Geological Survey in cooperation with the State of Montana, Proposed Surface Coal Mining Operation, Spring Creek Mine, Northern Energy Resource Company, Big Horn County, Montana

Spring Creek Coal Company proposes to open the Spring Creek mine in Big Horn County, Montana. Within 25 years an estimated 243 million tons of low-sulfur coal would be removed from about 1,850 acres within the 4,420-acre permit area. The statement presents for consideration by the Secretary of the Interior a proposed mining plan and six administrative alternatives related to Federal leasing and reclamation.

A The discussion of coal members, mining, and other phases of the project are adequate. However, the reclamation section could be strengthened by referring to experiments conducted at the Colstrip mine 60 miles north of the proposed minesite and to other reclamation research in the phosphate fields of southeastern Idaho.

Specific Comments

B Table 1-4, pages 1-44 and -45. There appears to be an arithmetic error because several of the columns do not add to the totals indicated (see three right-hand columns).

C Page iii, under 3.C. Disturbed areas need not experience "long-term loss of productivity." Disturbed areas at Colstrip showed excellent brush and grass growth in 3 to 4 years with recovery dependent upon the application of fertilizer and water. Plots without seeding, fertilizer, or sprinkling resseeded themselves in 10 years and became more productive than undisturbed ground. Photographs and statistics of the Colstrip reclaimed area would greatly enhance the Spring Creek mine reclamation discussion.

D Page iii, under 3.F. The above comment is also applicable to the statement that the "carrying capacity" for livestock and wildlife would decrease. Just the opposite has been the case. It seems that the statement should emphasize this potential productivity increase.

A As stated in chapter I, Background and History, "the mining and reclamation plans described in this statement were prepared on the basis of information and maps furnished by Spring Creek Coal Co.***." The authors are aware of ongoing reclamation endeavors at Colstrip as well as at other Montana and Wyoming mines; however, to make reference to reclamation experiments, although appropriate within the analysis section of the statement, would only obscure the reclamation plans as proposed by the company.

B Table I-4 has been corrected.

C The situation at Spring Creek is different than at Colstrip, see chapter III, Soils, Reclamation, paragraph 5.

Impacts are predicated on site specific conditions (i.e. high topsoil salinity and highly sodic overburden) and on the proposed mining and reclamation plan.

The comment cites increased productivity (no baseline cited) the impact statement refers to reduced potential productivity.

D Carrying capacity is a function of soil condition (resistance to grazing pressure), productivity, and plant diversity. This is clear in the statement.



E Lacking in this environmental statement is a discussion of soil mechanics or of the improved permeability and increased water retention of soil in disturbed areas. These data are available from other similar areas such as the Colstrip reclamation area.

F Page I-3, fourth paragraph. We assume that the intent of this PURPOSE Section is to cover the advantages of this potential coal production. If that is the case, it should be strengthened especially to stress the Nation's future needs for energy from coal.

G Spring Creek Coal Company committed itself on two contracts to deliver 12 million tons of coal a year. The proposed mining plan considers production of 10 million tons a year. This difference should be clarified.

H Page I-3, fourth paragraph, I-7, last paragraph, and I-29, second paragraph. Some confusion exists between "entire holdings" and "permit total." Figures on page I-7 show 3,306.27 acres for the permit total and on page I-3 and I-29, 4,420 acres for the entire holdings. The two figures should either be explained in more detail or, if in error, corrected.

I-1 Section 2. Biological Air Quality Impacts, pages III 8-10. It would be well to state in a. Wildlife and Domestic Animals and b. Terrestrial Insects that the trace elements discussed seldom occur in elemental form. The Bureau of Mines has found as many as 60 trace elements in different coals tested in the United States but which in a natural state exist primarily in mineral form. It would also be well in citing the various elements thought to be toxic to know which potentially occur in the overburden and the coal at the project site. It seems that in the desire to list all possible impacts, the citing of specific cases may not always be applicable to this analysis. Under c. Human Effects, it might be well to add that dust concentrations at existing surface mines measured by MESA in 1977 averaged about one-half that considered to the zero risk level. Further, it may be well to cite the report by the Nuclear Energy Policy Study Group, "Nuclear Power Issues and Choices," published in 1977, that states that it is anticipated that mining activity meeting conditions of the Federal Coal Mine Health and Safety Act of 1969 will involve little further occupational health impact from pneumoconiosis.

I-2

Some doubt has been expressed as to whether State and Federal law adequately protects surface mining employees' health (Gatzmeier, 1977). We have been unable to locate and review your reference to the 1977 study by MESA. We feel that it is appropriate to discuss the potential for respiratory health impacts to employees whose direct exposure to dust is long term.

(Gatzmeier, 1977, oral communication: Montana Workman's Compensation Division, Assistant Bureau Chief for Mine Health and Safety, December 29, 1977.)

E Soil mechanics is discussed in chapter III, Soils, General Mining Impacts. Due to loss of structure, sodic overburden and high clay and silt content, permeability in the surface 2 meters is decreased as are infiltration rates and water retention. These changes are well documented in Northern Great Plains research reports on mined lands (Arnold and Dollhopf, 1977, Ries and Day, 1978). Eastern mines frequently demonstrate increased infiltration and permeability due to more coherent overburden rock materials. Water retention, however, would be reduced under these circumstances.

F See text revision, chapter I, Background and History, Purpose.

G See text revision, chapter I, Background and History, Purpose.

H See text revision, chapter I, Background and History, Existing Coal Resource Holdings, Spring Creek Coal Co., and Figure I-16.

I-1 See text revisions, chapter III, Air Quality, Biological Air Quality Impacts, Wildlife and Domestic Animals, Terrestrial Insects, and Human Effects.

3 LETTER 9

We believe that the two statements: "Silicosis pneumoconiosis or simply silicosis develops through the inhalation of crystalline-free silica dust. Since 10 percent of the earth's surface is composed of quartz, crystalline-free silica is thereby an important constituent in all mining operations," can be misinterpreted. Although 10 percent of the earth's crust is silica, the amount varies widely between rock types and ores. Moreover, every State and Federal law dealing with the miner's well-being have stringent controls on the protection from silica dust. The phrase "crystalline-free silica" is probably "crystalline, free silica."

Dufresne
Acting Director



United States Department of the Interior

BUREAU OF RECLAMATION
Upper Missouri Region
P.O. Box 2553
Billings, Montana 59103

IN REPLY
REFER TO 160
120.2

Memorandum

To: Director, U.S. Geological Survey, Reston, Virginia

From: Regional Director, Bureau of Reclamation, Billings, Montana

Subject: Draft Environmental Statement, Proposed Surface Coal Mining Operation, Spring Creek Mine, Northern Energy Resources Company, Big Horn County, Montana (DES 78-30) (Mr. Jones' September 7, 1978, Memorandum)

A The proposed mine would have no effect on projects of the Bureau of Reclamation. The reclamation plan is apparently deficient. The statement points out (page III-2) that "severe rill and gully erosion would occur . . . to the proposed slopes;" that sediment is likely to increase (page III-4); and "a combination of saline and sodic spoils would render reclamation efforts ineffective" if the company proceeds with present plans (pages III-11 and 12). Although company-proposed alternative mining plans are discussed, they do "not offer any changes in reclamation procedure" (page VIII-30). We recommend the statement make it clear whether it is possible to develop an alternative reclamation plan which would avoid these effects or whether the apparent near-permanent loss of productivity is unavoidable if mining is conducted at Spring Creek.

B The figure 46 mmhos/cm on line 3, third paragraph, E.L., page III-10, should be 4.6 mmhos.

C The conclusion on page III-14 that revegetation has failed to demonstrate an ability to reestablish certain species and therefore ponderosa pine "would undoubtedly be lost" may be unduly pessimistic. Our staff observed volunteer ponderosa pine several feet high growing on unreclaimed spoil piles near Colstrip, Montana, several years ago.

D The discussion of the effects of different rates of mining on tax revenue and royalties received by governmental entities (page VIII-9) is misleading. The total revenue received would be the same (assuming the same rate prevailed throughout the period of mining); only the period over which it would be received would differ. We recommend the pertinent sentences be deleted.

E.R. Wills

E.R.W.

LETTER 10

cc: Director, Office of Environmental Project Review, Office of the Secretary,
Department of the Interior, Washington, D.C. 20240
Commissioner, Attention: 150

LETTER 10

IX-21

A See discussion under chapter III, Soils, Postmining Management, and the revised mining and reclamation plan, chapter VIII.

B The figure 46 mmhos/cm should be 4-6 mmhos/cm.

C We believe that experience to date indicates that ponderosa pine would be lost as a self-sustaining population for the long term. Site-specific impacts were based on the site-specific ecological parameters at the Spring Creek minesite, on the company's proposed mitigation measures, and on the experience of existing mines in their endeavors to establish ponderosa pine on reclaimed mined-lands. The experience at existing mines, however, cannot be directly transferred to the Spring Creek site for those reasons outlined in paragraph five of chapter III, Soils, Reclamation, of this statement; therefore, the observation cited in your comment, apparently referring to the Cape Oliver area at Colstrip, cannot necessarily be extrapolated to the Spring Creek area.

D See discussion under chapter VIII, Technical Alternatives, Coal Production Rates.

LETTER 11

**UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE**

Billings Area Office
Federal Building, Room 3035
316 North 26th Street
Billings, Montana 59101

October 11, 1978

IN REPLY REFER TO

CC

Dr. William Menard, Director
U.S. Geological Survey
National Center
Mail Stop 101
Reston, VA 22092

Dear Sir:

This letter constitutes the Fish and Wildlife Service's (FWS) comments on the Draft Environmental Statement of the Proposed Mining and Reclamation Plan for the Spring Creek Mine located in Big Horn County, Montana.

The EIS appears well written and documents most of the wildlife information necessary. There are a few omissions that should be brought to your attention, however:

- A** 1. Page I-17, 3rd paragraph; To "assume" that a company will design a powerline to avoid unnecessary impacts to eagles and other raptors could be very dangerous for eagles and other raptors. This should be a requirement and information as to how to do this can be obtained from many different sources, including the FWS.
 - B** 2. Page I-23; Reference is made to the relocation of the stream channels of two forks of Spring Creek. We recognize that these streams are of the ephemeral or intermittent type; however, any alteration of these stream channels will require some consultation with the FWS under the Fish and Wildlife Coordination Act. This should be pointed out in the EIS.
 - C** 3. Pages I-31 - I-35; No mention is made of the fact that postmining reclamation will require mining of soil to make up for shallow overburden. When one does finally read about this, it is way in the back under alternatives. Here it only discusses use of the soil for high-wall reduction. What happens to the "approximate original contour" requirement of the Surface Control and Reclamation Act? What are the impacts of mining the soil?
- During reclamation, topographic relief for wildlife must be reestablished as a reclamation technique. Will this require additional mining of soil. If so, what are these impacts?

A See text revision, chapter I, Proposals of the Spring Creek Coal Co., Construction of Facilities, Railroad and Powerline.

B See text revision, chapter I, Proposals of the Spring Creek Coal Co., Construction of Facilities, Water Diversion and Impoundment.

C Under the original proposal, there was no intent of borrowing overburden for the purpose of attaining the postmining recontoured surface. The "borrowing" of material was an alternative proposal by the company for the reduction of highwalls. The impacts associated with the "borrowing" of additional material are discussed in chapter VIII, Technical Alternatives Proposed by the Company, Highwall Reduction, Impacts from the Proposed Highwall Reductions. The Montana Department of State Lands and the Office of Surface Mining are presently reviewing the Spring Creek mining and reclamation plan. The company has been notified that the recontoured surface is unacceptable as presented and more topographic diversity must be portrayed before the recontoured surface will be accepted. Under the "Central Field Mine Plan" about 13 million cubic yards of overburden material are available for producing such diversity without disturbing additional acreage.



LETTER 11

The impact on wildlife of having a virtually flat area following reclamation was never mentioned in the EIS. This should be pointed out if there is to be no topographic relief provided for wildlife.

D⁴. Pages I-38 - I-39; Not once in the seed mixture is Big Sagebrush (*Artemisia tridentata*) included. Yet, within the EIS itself, this vegetative association is mentioned as being of the utmost importance to several native wildlife species. If this is to be excluded from the seed mixture, a discussion of this impact on wildlife must ensue.

E⁵. Page I-37; Seeding of vegetation is passed over rather quickly here. The reestablishment of diverse vegetative communities as well as diverse vegetation within the communities should be stressed herein. Otherwise, the impacts of not recreating these types needs to be more fully addressed.

F⁶. Nowhere in the impacts section is there a discussion pertaining to the effects large populations of people coming into a community will have on fish and wildlife populations. This must be addressed.

Too, is the subject of the proposed towns expected to "spring up" with the advent of the Spring Creek mine. Townsites have been chosen; yet, where do we find a discussion of this? What are the effects of this type of development on fish and wildlife?

G⁷. Page IV-1; Not one word has been proposed for mitigation of the wildlife populations that will be adversely affected by this project. It is interesting to note that in Chapter V and VI, one can find a brief statement addressing serious impacts to wildlife. Some thought should be given to proposals for a series of projects for mitigation.

H⁸. Chapter VIII; No alternative exists to the proposed action that considers wildlife. While an act which has language that indicates surface mining must "enhance fish and wildlife populations" before mining can proceed is in force, alternatives which address these wildlife values should be included as part of the EIS.

I⁹. There is no discussion of the impacts that contamination of groundwater by mercury could have upon the fisheries of the Tongue River Reservoir. While documentation may be limited, some discussion should be presented.

Thank you for the opportunity to comment upon this document. If you have any questions, please contact Mr. Raymond Hoem of my staff.

Sincerely,

Burton W. Rounds
Area Manager

cc: Western Energy and Land Use Team, Ft. Collins, CO

ATTN: Bob Streeter or Roy Irwin

Regional Director, ARD, Denver, CO (ENV)

ATTN: Harold Iyus

Director, USFWS/ES/EC, Washington D.C.

OSMRE, Denver, CO

Coal Project Manager, Washington D.C.

ATTN: Bob Stewart

D See discussion of the alternate mine plan, chapter VIII, Alternate Mining Plan - Central Field Mine Plan, Proposals of the Spring Creek Coal Company, Reclamation, Planting and Revegetation, and also response to letter 9-D.

The seeding discussion in chapter I, Proposals of the Spring Creek Coal Co., Mining and Reclamation, Seeding, is based on the company proposal.

E See revised seeding proposal in chapter VIII, Alternate Mining Plan - Central Field Mine Plan, Proposals of the Spring Creek Coal Company, Reclamation, Planting and Revegetation.

F See response to letter 29-A.

G See response to letter 3-A.

H See response to letter 3-A, chapter VIII, Alternate Mitigation Measures, Wildlife, and discussion of the alternate mine plan, chapter VIII, Alternate Mining Plan - Central Field Mine Plan.

I Several sampling and analyses errors have been noted by investigators. No conclusive results are available for the concentration of mercury; however, it is not anticipated that mining would significantly contribute to the amount of mercury in Tongue River Reservoir (Dr. Richard Gregory, Cooperative Fisheries Unit, Montana State University, oral communication).

United States Department of the Interior

DEPARTMENT OF THE INTERIOR
WASHINGTON, D. C. 20540

LETTER 12

Memorandum

To: Director, U.S. Geological Survey

From: Director, Heritage Conservation and Recreation Service

Subject: Review of Draft Environmental Statement, Proposed Surface Coal Mining Operation, Spring Creek Mine, Northern Energy Resources Company, Big Horn County, Montana

This is in accordance with your August 9, 1978, memorandum requesting review of the statement noted above.

Recreation

A Since population projections which take the Spring Creek Mine into account are available, we believe that a projection for needed recreation facilities should be included in the final environmental statement. The Montana Department of Fish and Game has completed an inventory of Montana recreation facilities, and has the results of a recreation participation survey done in 1976. This information can be used, in conjunction with the population projections given in the environmental statement, to determine what recreation development will be necessary to accommodate expanding population. This information can be obtained from Dr. G. Wesley Burnett, Chief, Planning Bureau, Parks Division, Montana Department of Fish and Game, 1420 E. 6th Avenue, Helena, Montana 59601, phone (406) 449-3750.

Cultural Resources

B-1 The statement lists 16 sites determined eligible for the National Register. Are these 16 sites a complete inventory of the area? If not, one should be made.

A See response to letter 3-C.

B-1 The 93 sites listed in table II-32 constitute all known sites within the areas surveyed (see figure II-24) at the time of preparation of the Spring Creek draft environmental statement. Additional lands, as identified in item 1 of Appendix N-1 (p. App.-63, DES) must be surveyed for the completion of the cultural resource inventory, as required under Executive Order 11593.

DES 78/30
CS

LETTER 12

B-2 The historical overview of the Indian situation (pp. II-94-96) is inadequate to predict the kinds of archeological sites that might be found.

The cultural resources (p. III-40) should be preserved in place until such time as they can be scientifically evaluated.



Chris Therral Delaporte

B-2 The historical record on plains Indian activity is sketchy, at best, and would provide little additional information as to the types of resources which might be encountered versus those which have been recorded. (See also responses to letters 1 and 21.)



United States Department of the Interior

NATIONAL PARK SERVICE
WASHINGTON, D.C. 20240

LETTER 13

IN REPLY REFER TO

L7621 (RMR)PC

Memorandum

To: Director, Geological Survey

From: **ACTING**

Director

Subject: Review of draft environmental statement for proposed plan of mining and reclamation, Spring Creek mine, Northern Energy Resources Company, Montana (DES 78-30)

We have reviewed the subject statement and offer the following comments.

There appear to be no apparent impacts on National Park System units. The population of Sheridan, Wyoming, is estimated to increase about 50 percent over the 25-year life of the mine and would probably decrease somewhat after the mine operation ceases. This could cause an increase in visitation to Bighorn Canyon National Recreation Area, but the extent of such possible increase is not known.

Your comments have been noted.



United States Department of the Interior

OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20240

LETTER 14

Memorandum

To: Director
Geological Survey

Thru: *16* Assistant Secretary
Energy and Minerals

From: *19* Acting Director
Office of Surface Mining

Subject: Comments on Spring Creek Mine Draft Environmental Impact Statement

The Office of Surface Mining (OSM) has reviewed the draft Environmental Impact Statement (EIS) for the proposed Spring Creek Mining and Reclamation Plan. Our comments on the draft EIS are attached.

Generally, the draft EIS does a very adequate job of pointing out the deficiencies and dangers in the proposed mine plan, but suggested mitigation measures are dealt with only superficially, or are absent altogether. Another problem with the draft EIS is that it deals primarily with the original plan submitted by the company-which has been changed significantly. After the Spring Creek mine plan described in the draft EIS is revised to meet requirements of the Initial or Permanent Regulatory Program, as applicable, and other State and Federal laws, OSM will prepare an environmental assessment (EA) of the potential of the proposed operation to comply with the regulations and the significant differences between the environmental impacts of the plan described in the final EIS and the final plan submitted to OSM for approval. OSM will use the EA to determine whether the new mine plan differs from the plan in the final EIS to such an extent that a new site-specific EIS evaluating the mine plan is required.

Our comments on the draft EIS are centered around several basic concerns, as follows:

1. Final Reclamation Contours
2. Final Reclamation Plan
3. Existence of Alluvial Valley Floors
4. Impacts on Surface Hydrology
5. Sediment Control System
6. Air Quality

LETTER 14

IX-27

The role of OSM is recognized in the processing of permit applications.
The modified mining and reclamation plan (chapter VIII) address most of the concerns expressed here.

LETTER 14

The draft EIS was very useful in facilitating our staff's review of the Spring Creek Mine Plan. Although OSM must review the detailed mine plan in all cases, a succinct, comprehensive DES saves us a lot of time.

This letter constitutes the official comments of OSM in the Spring Creek mine draft EIS.

LETTER 14

COMMENTS ON SPRING CREEK MINE DES

1. The final reclamation contours are not even close to the approximate original contours. Even though the thin overburden problems inherent in the mine plan make final grading very difficult, it is certainly within the realm of possibility to include more topographic relief and landscape diversity. This is particularly important for wildlife, which need topographic relief for escape, resting and breeding display areas. Consideration should be given to establishing rock mounds and rolling hills on the reclaimed area to mitigate the loss of wildlife habitat. In addition, the final contours of the railroad loop area and the scoria pit are not acceptable - they should blend in with the surrounding contours.

Attention should be given to calculating the volumes of available overburden (including material from the central bluffs area) as compared to the size of the void that will be created after coal removal. This would allow State and Federal reviewers to judge the accuracy of the proposed final contours. There is also no assurance that the sandstone from the central bluffs will be "mixed" evenly with the overburden or placed selectively on the overburden to create a buffer between the topsoil and the sodic/saline overburden to enhance revegetation success.

2. The final reclamation plan is deficient in many respects. First, there is not a specific plan for the redistribution of topsoil so that the sodic/saline soils problem can be minimized. Although the DES indicates serious topsoil problems, the mining plan does not recognize them. Second, the revegetation plan could be much improved to benefit wildlife after mining is complete. For example, more forb and shrub species should be included in the seeding mixture, a program of transplanting trees and shrubs could be implemented and efforts should be made to establish a variety of distinct vegetative communities.

3. The hydrology of the mine area is somewhat complicated because two drainages run immediately adjacent to the area to be mined and there is some question of whether alluvial valley floors exist. The mine plan has been altered to avoid mining within 100 or more feet of the drainages. Whether that will be adequate to prevent disturbance to the hydrologic balance needs further review. A cursory review of the hydrologic character of the drainages indicates the following:

Spring Creek is probably an alluvial valley floor, based on flood irrigation characteristics. Alluvium mapped on Figure 11-4 of the Environmental Baseline Report is shown to be up to 600 feet wide, a minimum of 150 feet wide and averages about 300 feet wide. Water yield of Spring Creek is about 500 acre-feet for the May-September period, as reported by NEKCo. This is sufficient water to flood irrigate the alluvium mapped. Soils are considered irrigable. Water sampling during May and July does not characterize irrigable water since it was collected in a very dry year from standing pools. Conductivity exceeded 2000 mmhos.

LETTER 14

Page 14
Spring Creek, Line 14

3. Comments

For similar reasons, South Fork is probably an alluvial valley floor. However, subirrigation in that area is not well understood. Water level are reported to approach within at least eight feet of the stream channel in one location. Further study is needed to determine subirrigation characteristics in this valley.

The DRS state that the Spring Creek valley fill is drained in the proposed mine area. As such, no subirrigation exists in the valley, and mining of coal in the central field will not affect the present situation.

The DRS states that alluvial waters of South Fork are unrelated to waters in the coal seam to be mined. A cursory review of available data indicates that this is the case. As such, mining of the central field will not affect the coal aquifer underlying the South Fork. Whether mining in the central field would affect the alluvial waters of South Fork is undetermined at this time.

4. Impacts to the surface hydrology and topography of Spring Creek are:

- (i) construction of two permanent diversions of the channel to accommodate plant facility construction.
- (ii) two stream crossings by haul roads.
- (iii) construction of the truck dump and primary crusher near the channel.

The diversions are unacceptable since they will channelize flood flows and cause downstream trenching. The company should be encouraged not to put the diversions in at all, but at a minimum, to redesign the present diversions. Windblown coal dust at some mines tends to collect in nearby valleys and should be of concern here since coal dust might collect in Spring Creek.

5. No diversion ditches are proposed on the north side of the boxcuts, and this may result in some sediment loads into Spring Creek. The secondary ditch has small settling ponds and it is unclear whether these ponds will discharge directly to Spring Creek or to the continuation of the diversion system. These are just two obvious problems with the proposed sediment control system and a more detailed review will be necessary before the present plan is approved.

6. Air pollution (specifically TSP) would exceed the Montana and federal standards several times per year at the proposed mine site. Provisions should be made for the tipples and loadout facilities to be covered. Best available technology should be implemented to control dust on haulroads as well as to control coal dust blowing off the railroad cars.



DEPARTMENT OF MONTANA
DIVISION FOR AGRICULTURE
PESTICIDE DIVISION

LETTER 15

HELENA, MONTANA 59601

TELEPHONE 442-2221
CABLE 442-2221
W. GORDON L. MYER
DIRECTOR

October 25, 1978

Mr. Craig Howard
Spring Creek Coordinator
Department of State Lands
1625 11th Avenue
Helena, Mt 59601

Dear Sir:

If the Spring Creek Mine in Big Horn County, Montana, is mined the destruction of the only perennial flowing water source (Spring on South Fork) on the mine site is imminent. If reclamation efforts are to be successful in terms of restoration of livestock utilization it is recommended that a perennial flowing water source be established at the earliest practical date during reclamation operations.

Your comments have been noted.

A telephone conversation with Neil Harrington on October 25, 1978 concerning the "sodic" overburden and "saline" topsoil has alleviated some of my concern about the suitability of the topsoil to be used in reclamation. I would appreciate a copy of the updated mining and reclamation proposal Mr. Harrington spoke of.

Sincerely,

Greg Pallister

Greg Pallister
Pesticide Specialist
Technical Services Bureau
Environmental Management Division

GP:mk

DCA

September 20, 1978

Mr. Craig Howard
Spring Creek Coordinator
Montana Department of State Lands
Capitol Station
Helena, Montana 59601

Dear Craig:

I have reviewed the draft environmental statement for the Spring Creek Mine in Big Horn County. I found the discussion of local impacts to be reasonably complete given the number of imponderable issues surrounding the Spring Creek mine project. The most important determinant for assessing where community impacts will occur is the location of housing for the coal mine workers. As the ES points out, housing in Southern Big Horn County is virtually non-existent. The ES anticipates that 90% of the population growth resulting from the mine will impact the communities of Sheridan County, Wyoming and, in particular, the City of Sheridan itself. Two recent proposals for providing worker housing could reduce the potential impact on Sheridan if either or both are successfully completed. According to recent press reports, the Big Horn County Commissioners have approved the Northern Energy Resource Company's (NERCO) proposed facility for temporary housing of approximately 300 mine construction workers. This would relieve some of the pressure on Sheridan's housing supply. The second proposal is for a new community which would be developed three miles east of the Spring Creek Mine. The ES correctly assesses the difficulties of this particular project when it states that, "a problem which faces any developer of a town or residential subdivision is locating a suitable site in the area which is not underlain by stripable coal." This is the very issue which provides the most serious threat to the new town proposal at present. The U.S. Bureau of Land Management issued a press release last week which criticized the new town location because the 320-acre site sits on top of \$60 million of Federal coal. If this conflict can be resolved the new town proposal probably offers the best practical means of mitigating the impacts which would otherwise fall completely on Sheridan, Wyoming.

LETTER 16

LETTER 16

LETTER 16

Mr. Craig Howard
September 26, 1978
Page 2

I found the ES's description of the status of planning in Big Horn County to be essentially accurate. I am less familiar with the situation in Sheridan but from all the reports I have heard, the comments regarding planning activities there also seem correct. I have enclosed portions of a case study of Sheridan, Wyoming prepared by a Colorado planning firm for EPA which contains a rather interesting assessment of the status of planning in Sheridan. Based on the comments in the case study I would probably be skeptical of the statement in the ES (page III-36) that, "the rapid growth and associated strains on all aspects of government would break down the traditional reluctance to plan." To date, the local political leadership seems to feel that local growth impacts are still tolerable and that a "creative and responsive planning" effort is not necessary. Sheridan seems somewhat atypical in that we have not seen the demonstration of general public concern that we usually find in other areas undergoing dramatic growth impacts from mineral development.

A See text revision, chapter III, Land Uses, Impact on Planning.

B I would offer one correction. Table I-1 on page I-2 lists the Montana Department of Community Affairs as an authorizing state agency for building construction and housing. This department has no direct regulatory authority in this area, but does serve in an advisory role to local governments for major subdivision proposals.

Thank you for the opportunity to comment.

Sincerely,

David Cole

David Cole, Chief
State Land Use Planning Bureau
DCA/Planning Division
(406) 449-3757

DC/ke

cc: Director, U.S. Geological Survey

B Table I-1 has been corrected.

ACTION HANDBOOK

Growth Management
for
Small Communities

SHERIDAN
WYOMING

EPA
Prepared June, 1977 For
ENVIRONMENTAL PROTECTION AGENCY
U. S. Government

Contracted By 68-01-3579
BMML
BRISCOE MAPHIS MURRAY + LAMONT INC.
Boulder, Colorado

Contents:

Preface	1
1 INTRODUCTION.....	5
2 SUMMARY.....	7
3 SHERIDAN TODAY.....	11
4 SHERIDAN TOMMORROW?.....	14
NATURE OF PROPOSED DEVELOPMENTS.....	14
POTENTIAL IMPACTS.....	19
PROBLEMS AND OPPORTUNITIES FROM GROWTH.....	23
5 MANAGING THE GROWTH.....	28
GETTING ORGANIZED AND INVOLVING THE COMMUNITY.....	29
ARRIVING AT A CONSENSUS OF WHAT THE PROBLEMS AND POTENTIAL IMPACTS ARE.....	32
SETTING COMMUNITY GOALS.....	40
SETTING PRIORITIES FOR ACTION.....	44
TAKING ACTION.....	45

Appendices

- A GOALS AND POLICIES
- B EXISTING CONDITIONS IN THE SHERIDAN AREA

PREFACE

The City of Sheridan, its neighboring communities, and the rural areas in Sheridan County will be facing major impacts from the growth associated with the development of energy resources in the area in the next five to ten years. Even though some of the development plans are uncertain at this time, the local government leaders and the citizens of the Sheridan area cannot afford to wait for final decisions to be made; if they do, it will be too late to take the necessary actions to plan for and manage the growth.

The Sheridan area has already seen the effects of increased population and development since 1970. Growth in Sheridan County has occurred at an average rate of about 3% per year over the past six years; population in the City of Sheridan has averaged an annual increase of about 3.5% in the same period. If all of the proposed energy developments -- coal mines, power plants, and coal gasification plants -- come into being within the next ten years, the City of Sheridan could see another 22,000 people living in the community. An additional population of about 14,000 could be living in the other communities and the rural areas of Sheridan County.

Mayor Russell York and the City Council of Sheridan, along with County Commission Chairman William Laya and the other commissioners, agreed, in the spring of 1976, to participate in an effort, financed by the Environmental Protection Agency, to evaluate the nature of the potential impacts from energy resource development. The study was to

Tables

IV-1	ENERGY DEVELOPMENTS AFFECTING SHERIDAN COUNTY, WYOMING.....	17
IV-2	TOTAL ADDED POPULATION FROM COAL MINES, CITY OF SHERIDAN.....	18
IV-3	PEAK EMPLOYMENT FROM POTENTIAL POWER AND CONVERSION PLANTS, SHERIDAN AREA.....	19
IV-4	PEAK ADDED EMPLOYMENT IN THE SHERIDAN AREA (ESTIMATED).....	20
IV-5	POPULATION ADDED BY CONSTRUCTION AND OPERATION PHASES.....	21
IV-6	LAND USE, PUBLIC FACILITY AND EMPLOYER IMPACTS.....	22
B-1	SHERIDAN CITY AND COUNTY POPULATION.....	B-1
B-2	MAJOR EMPLOYERS IN THE SHERIDAN AREA.....	B-4

Illustrations

III-1	SHERIDAN URBAN AREA.....	13
IV-1	LOCATION OF EXISTING AND PROPOSED COAL MINES IN SHERIDAN AREA.....	16

LETTER 16

include ways to evaluate the capacities and readiness of local plans and facilities to cope with the impact, and to generate ideas on what should be done to meet the challenge.

The citizens of the Sheridan area have repeatedly expressed their concerns about what may happen to the region, its way of life and its economy. They like their communities now, and want to continue to have pride in the area and to have a desirable place to live. However, we found that there is a substantial lack of knowledge or belief that major changes will occur and a lack of a consensus about the community's role or ability in planning for and managing the growth. The following report is the result of the consultants' review, based on brief visits and analysis of the available information.

Basically, we found political leadership and community support to be reasonably good under the present circumstances, but possibly inadequate to deal with the potential changes. Programs, facilities, and the quality of living are above average, and certainly better than in many western communities that have experienced energy-related growth and development. The Sheridan Area Planning Agency and its director, Les Jayne, have collected background data and prepared plans for the county and the several communities; this is a good beginning toward meeting the challenges.

However, if the proposed energy developments in the area go forward in the next few years, the growth could easily outstrip the current plans and ability to deal with the growth. The codes, plans and facilities that presently exist will be totally inadequate to cope with the problems. The area will have to accept development wherever and however it happens, unless steps are taken soon to provide the county and the communities in the area with the leverage they need to get some control over the developments and the impacts.

We have not attempted in this report to lead the elected and appointed officials of the area step by step through the Action Handbook, nor have we attempted to preempt the professional staff which exists from doing their jobs by going into detail about management processes, programming and budgeting procedures, and the like.

We have made some suggestions and recommendations in these matters, and have made liberal reference to the pertinent sections and chapters of the Action Handbook. Sheridan and the County have established mechanisms and procedures for dealing with the day-to-day aspects of conducting the government business; while these mechanisms and procedures might benefit from some of the suggestions of the Action Handbook, we have not analyzed the existing system for such detail and therefore make specific recommendations. We trust that wherever changes will be advantageous, the local staffs will be able to evaluate them and make those that would improve the ability for programs to deal with the impending growth.

The major emphasis in the case study for Sheridan is on the citizen involvement aspect, reflecting our observation that this is the most immediate and relevant problem facing the Sheridan area. Without citizen involvement in and support for the planning and management process, there is little chance of a successful program occurring. Without local control over what happens and how and when it happens, there is every chance that decisions affecting the Sheridan area will be made outside the area and imposed upon the local citizens, who would have little to say about the end result.

There is much to be done in Sheridan, and relatively little time in which to accomplish the task. The experiences of the Sheridan area in recent years, and the experiences of such nearby communities as Gillette and Colstrip should provide the impetus for action.

We regret the decision of the Council and Commissioners to withdraw from the Sheridan Area Planning Agency. We have viewed this cooperative effort under official sanction as a major tool for coordinating planning processes and action programs. The City and the County must now make every effort toward cooperation, coordination, and joint planning and programming if efforts to manage the growth are to result in preservation of that which is good in Sheridan and avoidance of that which can destroy the area. The comprehensive plan is just the beginning of the process; it is not the end. Experiences in other regions have repeated demonstrated that a joint City-County effort can provide a common ground on which to discuss and work out common problems. Separate efforts, without some joint membership group, invariably lead to friction between the planning efforts of local governments and wasting of time, energy and money. Commonality of planning goals and ways of reaching them gains tremendously from joint efforts.

Hopefully, a re-examination of the logic and reasons behind the withdrawal will permit the legislators to a restructuring, if necessary, and a resurrection of the concept.

SECTION I: INTRODUCTION

In the spring of 1976, the Environmental Protection Agency (EPA) issued a contract to Briscoe, Maphis, Murray and Lamont, Inc. (BMML), a government management consulting firm in Boulder, Colorado, to prepare a handbook for use by communities anticipating growth impacts from energy development in the Rocky Mountain region. The report is entitled, Action Handbook for Small Communities Facing Rapid Growth. As part of that contract, the EPA requested that two communities be included as case studies. The purpose of the case studies was to evaluate the preparedness of the communities to deal with a large influx of workers from construction and operation associated with new energy development in their regions and to suggest actions that would help them cope with future growth.

In order to select communities for the case studies, BMML visited with various state agencies in an attempt to select communities which would be open to working with the consultants, which anticipated growth impact from energy development, and which had not already been studied to death. The Wyoming State Planning Coordinator, David D. Freudenthal, recommended that the City of Sheridan would be a very good choice to work with as part of the Action Handbook. Mayor Russell York, the City Council, the Sheridan County Commissioners (William Laya, Chairman), and the Sheridan Area Planning Agency (John McWilliams, President) agreed to work with the consultants in this effort.

During the ensuing months, representatives of BMML visited Sheridan, collected data and information, and began an overview analysis of the potential impact in Sheridan from

SECTION II: SUMMARY OF OBSERVATIONS

LETTER 16

energy development. As is all too typical, the situation as far as potential impacts is concerned is one of uncertainty. There is a reasonable amount of information available concerning potential coal mining activities in the Sheridan area -- both in Wyoming and southern Montana, although the questions of when the mining will begin are largely unanswered. Because of Federal coal leasing regulations, it can be expected that most, if not all, of the potential operations will begin sometime within the next ten years. The other potential developments in the area -- power plants and coal gasification plants -- are more difficult to assess, particularly where the timing of development is concerned. Our conclusion was that the development of all the potential facilities should be anticipated and expected to occur within a relatively short time span -- not more than ten years.

This document is not a comprehensive plan for Sheridan, and is not an attempt to duplicate the work and studies that have already been done by the Sheridan Area Planning Agency (SAPA) and others. It evaluates the current setting of the community as to its problems, its current capabilities and its opportunities for managing new growth. It suggests areas where improvements could be made before more growth occurs, and recommends actions which the community can take, based on the goals and policies suggested by representatives of Sheridan and the other communities in the county. It is not assumed that the goals and policies contained in this report or the goals and policies contained in the Community Development Plan have been accepted or adopted by the community. These goals and policies have, however, been publicly reviewed and can provide a good basis from which to move the program forward in Sheridan.

Based upon our visits to Sheridan and the discussions we have had with local government officials and community leaders, we have several observations about the community's preparedness to cope with the potentially explosive growth which is likely to occur:

- . A sense of direction and commitment to cope with the growth is missing in Sheridan and Sheridan County.

Growth resulting from the mines and the power and conversion plants could increase the population in the City of Sheridan by nearly 22,000 by 1985 if all the proposed energy facilities are developed in the next 7-10 years. Population in the remainder of the county could increase by another 14,000 in the same time period. There is a need for communitywide awareness of this potential, and concentrated commitment to prepare for the growth. The Planning Commission and staff are not capable of accomplishing the task that must be done without support from the citizens and political leaders in the area.

Change has already occurred and the climate is right for major growth problems to occur in Sheridan.

A reluctance to accept or lack of knowledge of how to arrive at a consensus of direction, set policies and revise current standards and revenue sources will limit the area's ability to deal with the change.

LETTER 16

- . The lack of a Comprehensive Plan and policies that are committed to by the City Council, the County Commissioners and the citizens increases the difficulty for advisory boards, staff and developers to know how to proceed.
- There is a good background of information that has already been collected by the Planning Agency and the city staffs. Plans have been proposed. There is a need to review and evaluate the existing information and proposed plans, revise them where necessary, and then make an official commitment to a course of action.
- . The lack of land use control in the county will forfeit local control over where, when and how the energy developments and the related population growth will be accommodated.
- Sheridan has an outstanding physical setting and is a very attractive area in which to live. It could be destroyed by marginal developments over which there is little the county can say at the present time.
- . Policies concerning annexation, utility extension, finance, zoning, subdivision review, housing and utility management need to be examined by the City of Sheridan and the other communities in the county and revised to reinforce the community's goals.
- . There is a lack of attention to or concern with the details of how development occurs; this will take its toll on the appearance of the community when rapid growth takes place.
- Building location and bulk, landscaping, signs, pedestrian considerations, etc., all need to be considered if the community is to remain attractive.
- . Procedures for development review need clarification, simplification and, above all, a clear set of policies - committed to by the community leaders - that can be used to judge development proposals.
- . The agricultural portion of the local economy can be in jeopardy if urban development is allowed to scatter along the river bottoms where the irrigated farm land that complements the dry-land grazing occurs.
- . The potential for major housing deficiencies and service problems is very great in the Sheridan area, due to a lack of belief that rapid growth will occur and that it is beyond the current ability of local facilities to deal with.
- . The older portion of the community is generally in good repair, has a comfortable, pleasant and attractive character; this needs to be protected.
- . A decision as to whether the downtown area is to be encouraged to preserve itself and continue as the center of the community for a multitude of purposes must be made soon, before any additional business and commercial uses are approved in outlying areas.
- . The basis of facilities and services for future growth exists in Sheridan, but there is a need to plan now to rectify existing deficiencies as well as for expansion to meet new needs.

LETTER 16

The lack of functional plans for the physical facilities and strategies to implement them will inhibit timely new development and threaten the quality of life for existing residents in Sheridan and Sheridan County.

SECTION III: SHERIDAN TODAY

The City of Sheridan, seat of Sheridan County, lies in a fertile valley at the foot of the Big Horn Mountains in northern Wyoming. The community is surrounded by irrigated farm lands in the valley and dry-land farms and grazing lands on the terraces which overlook the flood plains of Big Goose and Little Goose Creeks. Strippable coal deposits are prevalent in the areas north of Sheridan, both in Wyoming and in southern Montana. The community's location midway between Billings, Montana, and Casper, Wyoming, and between the Black Hills of South Dakota and Yellowstone National Park in Wyoming, makes it a stopping place for tourists and travelers driving between these larger cities and between the vacation areas. The location and environment of the Sheridan area have been major factors in the development and economy of the City of Sheridan and the county.

Sheridan is the largest trade center in northern Wyoming and the southeastern part of Montana. Its essential character is that of a small western town with its roots in the westward movement and the development of the railroad and agricultural and mining industries. Residents have a high degree of pride in their community and a self-reliant attitude which is cool toward government or other outside intervention in the affairs of the town. Attitudes toward the development of mining and other industries vs. preservation of the agriculture and the environment are diverse, as might be expected in areas which are facing changes resulting from the development of the nation's energy resources.

The incorporated area of the City of Sheridan comprises just over four square miles; another 17.8 square miles is

LETTER 16

included in the fringe area. (See Illustration III-1). Within the incorporated area, 83% of the land is developed; in the fringe area only 15% is developed. Housing in Sheridan occupies about 1/3 of the land; single-family housing is predominant. Mobile homes have become an increasing factor in the area's housing supply since 1970, with most of the mobile homes located in the fringe area. The cost and supply of housing are critical problems in the area, with vacancy rates in the city and county averaging less than 2%.

Population trends in the City of Sheridan and Sheridan County have fluctuated since the early part of the 20th century, depending largely on the fluctuations in the mining and agricultural activities in the region. The county's population has increased by nearly 3,000 in the past six years, due to the increasing demand for coal production and the increased job opportunities which have been made available as a result of the opening of new mines in the area. (See Table B-1, Appendix B).

The region's economy has historically been based on coal mining and agriculture; the City of Sheridan has served as the trade center for the surrounding rural areas. Tourism is also a major factor in the area's economy, as is federal, state and local government employment. (See Table B-2, Appendix B).

Appendix B includes a more detailed summary of population trends, economic base, land use and development, housing, transportation, utilities, facilities and services. The proposed Community Development Plan for Sheridan, prepared by the SAPA, includes even more detailed analysis of the existing situation and projected needs of the City of Sheridan.

STATE OF MONTANA

LETTER 17

DEPARTMENT OF

FISH AND GAME

Helena, MT 59601
August 21, 1973



Director
U. S. Geological Survey
National Center, Mail Stop 108
Reston, Virginia 22092

Dear Sir:

After a review of the vegetative and wildlife portions of the Proposed Mining and Reclamation Plan for the Spring Creek Mine, I have several comments to make. It is clear from the document that the proposed mine will have a major impact on wildlife, more so than any presently operating or proposed mine that I am familiar with in Montana. As was vividly pointed out in the document, losses of antelope, sage grouse and mule deer habitat as well as many other species habitat will be severe. Given this fact, if there were ever a reason to deny a mining permit on the basis of wildlife and other environmental losses, this would be the place to start. This authority seems to exist under both the state and federal mining laws.

While the reclamation plan includes an attempt to create a mosaic of vegetation types, it is obviously far less complex than the existing situation. Also obviously lacking from the reclamation plan are attempts to reestablish the big sagebrush and ponderosa pine/juniper types which presently comprise more than 50 percent of the area and are so vital to wildlife using the area. Postmining stream reclamation does not specify what materials will be used for the channel substrate, and the floodplain vegetation plan does not include any woody riparian species such as willow, ash or cottonwood. Both of these omissions should be corrected. Woody riparian species should at least be planted around the proposed reservoirs.

The alternate mining plan (Central Field Mine Plan) presented by the company would be more acceptable because of its reduction in wildlife habitat destruction and virtual elimination of the need to rechannel two intermittent streams. However, the alternate plan would still have a major impact on wildlife in the area.

Impacts to some other wildlife groups such as raptors, some game birds, song birds, etc. were judged to be insignificant. However, if present and other proposed developments in this general area are considered

LETTER 17

Director, U. S. Geological Survey -2- August 21, 1978

as they should be, these insignificant incremental impacts become substantial. Because of the numerous potential developments in the Decker area, an impact statement for the entire area should be prepared so that a long-range development plan for the area could be formulated.

Thank you for the opportunity to comment.

Sincerely,



Robert R. Martinka, Chief
Baseline Studies Bureau

RRM/sd

cc: Environmental Quality Council
Montana State Clearinghouse
Keith Seaburg
Craig Howard
Ray Hoem

A Cumulative impacts on wildlife from coal development in the Decker subregion will be discussed in a regional environmental statement for the Northern Powder River Basin, Montana.

LETTER 18
STATE DEPARTMENT OF HEALTH
AND ENVIRONMENTAL SCIENCES

Office Memorandum •

TO : Fred O. Gray DATE: August 30, 1978

FROM : JoAnn E. Vorozilchak

JoAnn

SUBJECT: Spring Creek EIS

I have reviewed the Spring Creek EIS.

The section describing present air quality (pp II-18-11-20) might be better reviewed by Jim Gelhaus since he apparently provided the information.

The impacts on the air quality (pp III-6-III-10) have several errors.

A In listing the pollutants resultant from mining (1). Air Quality, para. 2) hydrogen sulfide and hydrocarbons should be included. The hydrocarbons coming from both the diesel or gasoline powered equipment and the ANFO used for blasting. The hydrogen sulfide would be formed by the coal bank fires mentioned later in this section.

Under Primary Impacts, paragraph three is written strangely - is there such a thing as "The maximum allowable Montana Guidelines"? How do we know when we have too many Montana Guidelines?

B Speaking of the emission of gaseous pollutants; I believe hydrocarbon emissions would also result from blasting if ANFO is used. Having lived near and having studies burning coal banks and coal mine fires I know the main gaseous pollutants are hydrogen sulfide, sulfur dioxide, sulfur trioxide, carbon monoxide and perhaps hydrocarbons. The similarities between coal bank fires and coal fired power plants are small. Coal bank fires normally are persistent wildfires which due to inadequate oxygen have incomplete combustion and have products reflecting this incomplete combustion. Coal-fired power plants are designed to burn coal as efficiently as possible because incomplete combustion is inefficient and a waste of the money spent to buy the coal.

Besides being noxious some of these pollutants do combine with water vapor when available, and form an acid mist.

C Under Primary Impacts, paragraph seven, I find the 2 percent loss of coal as dust from the open coal cars unbelievable and unconscionable because when the mine is producing 10 million TPY the loss would amount to 200,000 TPY. That would be enough coal to run the Corette plant for at least 89 days. The coal yard boss at the Corette plant said that while he hasn't any scientific proof he has seen things he has drawn on top of the loaded coal cars at Colstrip appear exactly the same when unloading them in Billings. Cars may show a weight loss due to moisture loss but losing 2 tons of coal per 100 tons doesn't seem believable. At a 2% loss rate it would be profitable to treat the coal to reduce the loss as some of the mines are doing.

A Although not mentioned under primary impacts, hydrocarbon emissions from internal combustion engines are shown in table III-1. Experimental blasting tests have not revealed significant hydrocarbon emissions (Chaiken, and others, 1974). Sixteen percent of the total gaseous emissions at the proposed strip mine are hydrocarbons, which in these amounts are less harmful to human health and living organisms than either sulfur dioxide, nitrogen oxides, or carbon monoxide.

B See text revision, chapter III, Air Quality.

C See text revision, chapter III, Air Quality.

In a study involving the transport of Rosebud seam coal from Pekin, Illinois, to Grand Forks, N.D., researchers collected coal dust off a single coal car in two dust collectors, placed at either end of the car. If one assumes that coal dust is lost only from the front or back of a coal car, and not from the sides, and that the samplers were accurate, 0.0002 percent of transported coal is lost within the first 50 miles of transport (Paulson, and others, 1976). This would amount to a minimum of 20 tons of coal dust per year, or 800 pounds per mile per year along the railway corridor from the Spring Creek mine just beyond Sheridan, Wyoming.

Controlled wind tunnel measurements of coal dust lost off eastern coal show that at a wind speed of 26 miles per hour, coal dust loss is 0.2 percent, and at 46 miles per hour it is 0.42 percent (Nimerick and Laflin, 1977). The sieve analysis of the eastern coal had 75 percent less coal dust below 75 microns than the Rosebud coal (Paulson and others, 1976; Nimerick and Laflin, 1977). This means that potentially fewer particles were likely to be blown off the eastern coal than the western coal in the cited experiments. Although eastern coal has a moisture content of 9 percent as opposed to the 25 percent of western coal, this moisture is surface moisture, inducing less slacking than does the inherent or internal moisture of western coal.

Assuming that coal dust would fall out within one-half mile of the railroad tracks, dustfall would amount to at least 0.03 tons/mi²/3 months.

These are the only experimentally valid measurements of coal dust lost off unit trains known to the State task force at present. More information is needed. With the information available, we predict losses off unit coal trains to be between a minimum of 0.0002 percent and a maximum of 0.42 percent.

LETTER 18

D Larry Fox at Peabody Coal says they have studied the coal loss between their mine and its destination - Kohasset, Minnesota - and have found the loss to be less than 1% with an average loss of 0.2% which was low enough to make treating the coal unprofitable. Mr. Fox offered to look up their data to substantiate this.

E I notice Table III-1 does not include this loss of coal. This table does not indicate whether personal vehicles are part of the population increase or whether mining vehicles or personal vehicles are indicated by the "vehicles" source or are mine vehicles under "Mining (all operations)"?

Under Biological Air Quality Impacts: Wildlife and Domestic Animals there is only one vague reference to animals other than cattle.

F I was surprised to learn that honeybees are terrestrial insects and that there aren't any air pollution impacts on vegetation.

G Human effects - Strip miners exposure to dust is rather limited because most of the equipment have fully enclosed cabs. It would be more accurate to indicate the occurrence rate of silicosis, pneumoconiosis,^b and industrial bronchitis among coal strip miners, than among coal miners in general since the underground mining working environment is vastly different from the strip mining working environment. The Montana Department of Labor and Industry was not aware of any strip miners who have developed these "coal miners diseases."

Dr. Bergren does not appear to be aware that anthracosis and anthra-silicosis, which is a form of silicosis rather than plain pneumoconiosis, are the names given to pneumoconiosis and silicosis, respectively, when they are contracted by the anthracite coal miners of Pennsylvania and their common name in the anthracite region is "miners asthma" - "black lung" is a more modern name arising in the days of lung x-rays, autopsies and government relief programs.

Human Effects - the author of this section obviously did not read Bergren's statement which forms Appendix D-4. Silicosis is related to the crystalline-free silica content of the overburden and the coal; it is not related to the carbon content of the coal and it is the intermediate particle size (0.5-5.0 micron) which lodge in the lungs to cause silicosis. Finer particles remain suspended and are thus exhaled and large particles are removed by the ciliated cells along the respiratory tract. Pneumoconiosis is related to the inhalation of carbon, as coal dust. Industrial bronchitis is caused by inhaling any dust for prolonged periods of time, it is found in many occupations.

Increased respiratory ailments among the general population are found in mining and smelting communities - Butte and Anaconda are evidence of this. Bergren cites Enterline's studies as grounds for the possible bacteriological contagiousness of chronic bronchitis among coal miners families. More recent studies among asbestos workers have shown a development of asbestosis among the families due to handling the dust laden clothes; a similar case could be drawn for coal miners families. Elementary procedures such as showering and removing work clothes at the job and gentle handling of the clothes when preparing them for washing could reduce the risks to the family.

D Peabody Coal Co. has been unable to substantiate the coal dust loss that you have quoted. Unfortunately, their data did not include a control for moisture change in transported coal. At our request, they analyzed their data and found a mean annual loss of 2 percent that was statistically nonsignificant due to the variance in loss (Vardiman, 1978).

E Gaseous emissions for population are a composite of expected vehicular traffic, home heating, construction, etc. Gaseous emissions for internal combustion engines are for mine vehicles, both diesel and gasoline. A breakdown of the dust emissions for the mine operations is given in Appendix D-3. Coal dust loss off unit-trains is a regional impact and is quoted in the text.

F The subheading "Terrestrial Insects" was used to prevent confusion with aquatic insects. Impacts of air pollution on vegetation are discussed in chapter III, Vegetation.

G See text revision, chapter III, Air Quality.

It is not possible to predict with any accuracy how emissions from the Spring Creek mine would affect human health. The EIS lists some possible adverse effects; the probability of their occurring cannot be assessed with available data. We are somewhat skeptical of the effectiveness of the present State and Federal regulations set up to protect the health of surface strip mine employees in eastern Montana, especially in the long term.

LETTER 18

Impacts on a new town would be dependent upon location in relation to the mine and prevailing wind direction and speed. Unlike Butte and Anaconda the Spring Creek Mine is not located in a basin enclosed by high mountains which would cause frequent, (almost daily), air stagnation and stratification.

My overall impression of the air pollution segments of this EIS is that the author was not striving to fulfill the purpose of an EIS, i.e. to present an informed, objective view of the proposed project and its affects on the environment. This is a difficult assignment since people do have personal opinions on the desirability of any project, but it must be attempted.

P. VIII-8. Underground mining of an 80+ feet coal seam is not technically feasible. Some European countries have obtained 80% resource recovery on 16-24 feet coal seams. An underground mine needs good roof material for development. If recovery of 80% of the coal seam were possible by underground methods the post-mining surface would have subsided 55-60 feet from the pre-mining topography. (Removal of 1 foot of coal disturbs 10 feet of overburden in underground mining.)

TYPOGRAPHICAL ERRORS

- P. II-20, line 15 below table, "for NO₂ ~~atmospheric~~³ (. . .
- P. III-6, line 37, 6. reclamation . . . revege ~~is~~
- P. III-7, line 4, assuming ~~no atmospheric~~ emission controls (no such thing as "atmospheric emission controls")
line 35, the leasehold.
- P. III-10, line 8, "bronchitis" - bronchitis
- P. III-10, line 3, (Bergen, . . .) in Appendix D name is spelled Bergren.
- P. App.-10, line 1, "Pneumoconiosis" - Pneumoconiosis
- P. App. 11, line 23, "Massive fibrosis" - Massive fibrosis



Department of Health and Environmental Sciences
STATE OF MONTANA HELENA, MONTANA 59601
LETTER 19

August 29, 1978

A C Knight M.D. FCCP
Director

M E M O R A N D U M

TO: Director, U.S. Geological Survey, National Center, Mail
Stop 108, Reston, VA 22092

FROM: Kenneth L. Quickenden, Ph.D., R.S., Vector Control Section *KQ*
Supervisor, Food & Consumer Safety Bureau

SUBJECT: Spring Creek Mine (Big Horn County, Montana) DES 78-30

Guidelines prepared by the Center for Disease Control, USPHS
(entitled: Prevention and Control of Vector Problems associated with
Water Resources and Highway Design and Construction Criteria for Prevention
and Control of Mosquito Production) are enclosed.

They are applicable to the EIS draft DES 78-30 concerning construction
of stock watering ponds wherein side slopes are planned to be 10 - to - 1
instead of more optimum 2 = 1 (page I-37). Section (h) Motor Diversion &
Impoundment, pages I-21 to I-25 calls for wide flat bottom ditches where
the Center for Disease Control recommends U or V bottom ditches to concentrate
low flows (if any) and minimize mosquito production.

KLQ:kes

Your comments have been noted.

EEO/AFFIRMATIVE ACTION AGENCY

LETTER 19

PREVENTION AND CONTROL OF VECTOR PROBLEMS
ASSOCIATED WITH WATER RESOURCES

1965
(Reprinted 1975)

Contents

I. INTRODUCTION	1
II. PUBLIC HEALTH AND ECONOMIC IMPORTANCE OF VECTOR PROBLEMS	2
III. NATURE AND EXTENT OF VECTOR PROBLEMS	3
Biology of Mosquitoes	4
Other Aquatic Insects	6
Terrestrial Arthropods and Rodents	7
IV. VECTOR PREVENTION AND CONTROL IN RELATION TO THE DEVELOPMENT AND UTILIZATION OF WATER RESOURCES	7
Mosquito Prevention and Control for Impoundments	8
Mosquito Prevention and Control for Irrigated Areas	10
Legal Considerations in Vector Control	11
Vector Control Activities of Various Agencies	11
Federal Agencies	11
State Health Agencies	13
V. REQUIREMENTS FOR PROVIDING ADEQUATE PREVENTION AND CONTROL OF VECTOR PROBLEMS ASSOCIATED WITH WATER RESOURCE DEVELOPMENTS	13
VI. GENERAL RECOMMENDATIONS	15
Impoundments	15
Terrestrial Arthropods and Rodents at Recreational Areas	17
Waterfowl Refuges	17
Irrigation	17
Project Conveyance and Distribution Systems	17
Project Drainage Systems	18
Irrigated Farms	18
Farm Ponds	19
Channel Improvements and Drainage	19
Waterways, Terraces, Floodways, Diversion Channels, and Drainage Ditches	20
Supplemental Chemical Control Measures	20
Routine Vector Appraisal	20
VII. SELECTED REFERENCES	21

UNITED STATES DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service
Center for Disease Control
Bureau of Laboratories
Vector-Borne Diseases Division
Water Resources Branch
Fort Collins, Colorado

PREVENTION AND CONTROL OF VECTOR PROBLEMS
ASSOCIATED WITH WATER RESOURCES

INTRODUCTION

Great expansion in the development of water resources has occurred during the last two decades in an effort to meet the needs of the Nation's growing population. This expansion will undoubtedly continue at an accelerated rate in order to keep pace with increasing demands for water, particularly for irrigation agriculture and to meet the needs of rapidly growing industry. It is now recognized that a wide range of interests must be given full consideration in the development and utilization of water resource projects in order to assure maximum benefits to the greatest number of people. One of these interests involves the prevention and control of insects which create public health hazards.

This pamphlet is limited to discussions of the various aspects of vector problems of public health importance associated with water resource development. In these discussions, vectors are considered as species which carry human disease organisms or which affect man's comfort, mental equanimity, and economic welfare.

It has been repeatedly demonstrated that water resource projects, especially impoundments and irrigation developments, create insect-vector problems unless appropriate prevention and control measures are provided. The effective prevention and control measures that were developed and incorporated into the design, construction, and operation of TVA projects and other impoundments throughout the Southeast played a major role in suppressing malaria in this country. In contrast, relatively little attention has been devoted to the prevention and control of other types of vector problems associated with water resource developments. As a consequence, the rapid expansion of irrigation and other water resource projects has usually been accompanied by proportionate increases in aquatic habitats favorable for the production of insects of public health importance. Mosquitoes are the most important of these insects although other groups such as deer flies, horse flies, black flies, biting midges, and the non-biting chironomids are often involved.

The public health importance of insect problems associated with water resource developments is increasing due to (1) the rapid increase in populations in existing irrigated areas where little or no attention has been given to control or prevention of vectors, (2) man-made aquatic habitats created by construction of new projects, (3) the increasing exposure of man to insects of public health importance due to expanded public use of water-related recreational areas, (4) the development of

LETTER 19

insecticide resistance, and (c) public demand for a more healthful environment. It is therefore urgent that programs for the prevention and control of insect-vector problems keep pace with the various other matters involved in the development and utilization of water and land resources.

PUBLIC HEALTH AND ECONOMIC IMPORTANCE OF VECTOR PROBLEMS

Several groups of arthropods and rodents associated with the development and utilization of water resources may create serious public health and economic problems. These include species that are vectors of disease organisms and species that serve as reservoirs of these organisms or otherwise interfere with man's health and welfare.

Approximately a dozen species of mosquitoes of public health and economic importance may be produced in habitats associated with irrigation, impoundments, and other water resource developments. Encephalitis, commonly known as sleeping sickness or brain fever, is now the most important mosquito-borne disease in the United States. Mosquitoes obtain the encephalitis viruses from birds and then transmit them to other host animals including horses and humans. There are no effective chemotherapeutic measures known for preventing or treating human cases, and some individuals, particularly children, who recover from encephalitis often suffer permanent disability. Three principal types of mosquito-borne encephalitis occur in the United States. Eastern encephalitis (EE) occurs mainly in the Atlantic and Gulf States from New Hampshire to Texas, but sometimes extends as far inland as Wisconsin. St. Louis encephalitis (SLE) occurs chiefly west of the Mississippi River and in several of the Central States and Florida. The third type, Western encephalitis (WE), is confined primarily to the States west of the Mississippi River.

Culiseta melanura and several species of *Aedes* mosquitoes are believed to be involved in the transmission of EE. The principal vector of both WE and SLE in the Far West is *Culex tarsalis*, a mosquito which is widely distributed west of the Mississippi River. In the Central States, mosquitoes of the *Culex pipiens-quinquefasciatus* complex are believed to be important in the transmission of SLE. In Florida, *Culex nigripalpus* is recognized as a vector of SLE. *Aedes* and other mosquitoes may also be involved as secondary vectors of encephalitis. Both Western and St. Louis encephalitis are endemic in many western areas, and outbreaks of WE among horses and of WE and SLE among humans have been rather widespread. In recent years, outbreaks of encephalitis have occurred in irrigated areas in the Texas High Plains (1956-1964), Intermountain States (1957 and 1964), Lower Rio Grande Valley (1957), Utah and New Mexico (1958), and Wyoming (1960).

The occurrence of malaria outbreaks as a result of improperly prepared reservoirs in the Southeastern States is well documented. Malaria has also been associated with irrigation in several States including

California, New Mexico, Texas, and in the rice-growing areas of the Mississippi Delta. This disease has been almost eradicated from the United States; and at present, there is no significant malaria transmission anywhere in the Nation. The malaria vectors (*Anopheles quadrimaculatus* in the East and *Anopheles freeborni* in the West) are still prevalent in some areas where favorable habitats are present. These mosquitoes constitute a potential hazard for the establishment of new foci of malaria transmission, particularly in situations where the disease may be reintroduced from foreign countries. This was well illustrated at Lake Vera in California during the summer of 1952, where 35 cases of malaria occurred among Camp Fire Girls. The source of their infections was traced to a soldier who had an attack of malaria while camping at the lake.

Aedes vexans, *Aedes dorsalis*, *Aedes nigromaculis*, and several other mosquitoes which cause severe biting annoyance to man and domestic animals are produced in habitats associated with irrigation and other water resource projects. These mosquitoes often create public health problems aside from the transmission of specific diseases. Such health hazards are illustrated by the results of surveys made by the U. S. Public Health Service in irrigated areas in northern Montana. In three-fourths of the families surveyed, mosquitoes severely annoyed both adults and children and interfered with their normal outdoor activities during the summer months. Mosquito bites caused some degree of injurious reaction in 8 out of 10 people interviewed; and in one section, 40% of the individuals examined by the physician showed evidence of secondary infection of mosquito bites. Some individuals, particularly children, frequently required medical attention and sometimes even hospitalization for treatment of secondary infections and allergic reactions caused by mosquito bites.

In addition to their public health importance, mosquitoes often create other serious problems in both rural and urban areas. Their vicious biting reduces the efficiency of farm workers and sometimes hinders the harvesting of crops. Dense populations of attacking mosquitoes have been reported to kill livestock. The constant attacks of even moderate populations of these insects may reduce the vitality of farm animals and prevent proper feeding, thereby causing reduced weight gains and lower milk and egg production. Mosquitoes are vectors of encephalitis, anaplasmosis, fowl pox, and several other important diseases of animals. These diseases kill large numbers of farm animals each year. Together, mosquito annoyance and mosquito-transmitted diseases undoubtedly result in losses of millions of dollars to farmers every year.

Large numbers of biting mosquitoes also cause serious economic losses by reducing the efficiency of industrial workers, lessening the value of real estate, restricting outdoor recreational activities, and reducing attendance at outdoor business establishments such as drive-in theaters and eating places.

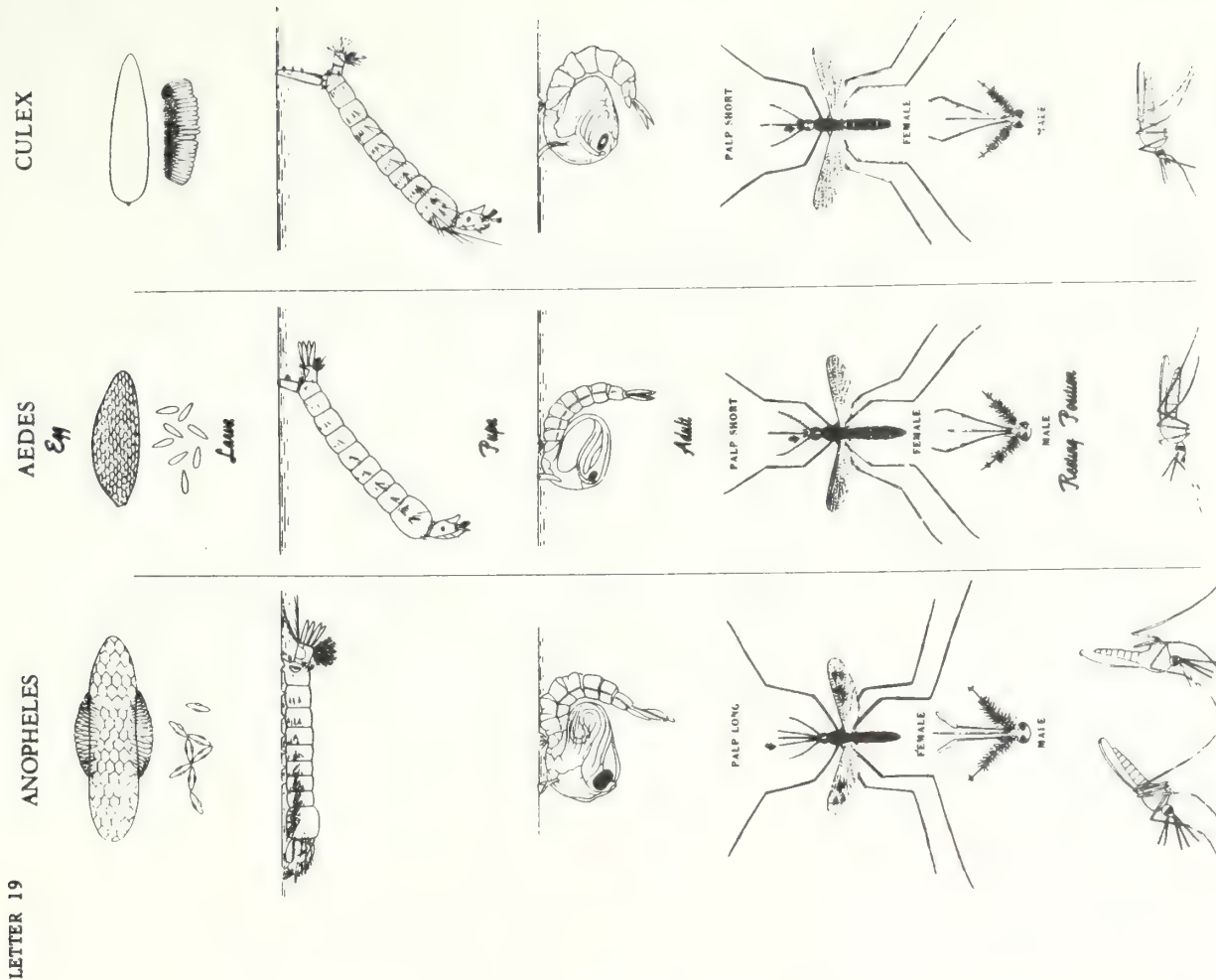


Figure 1. Characteristics of Anophelines and Culicines

The economic magnitude of the irrigation mosquito problem is illustrated by expenditures for abatement of these insects. For example, in California over \$6 million is spent annually to control mosquitoes, and it has been estimated that at least twice this amount would be required to provide adequate control throughout the State. The major portion of this mosquito control is carried out in irrigated areas. Approximately \$200,000 is spent each year for mosquito abatement in a few irrigated areas in Utah. Many urban communities in other western irrigated areas spend large sums of money each season for chemical control to provide partial protection from mosquitoes. Individual families also spend sizable amounts of money each summer for household sprays, mosquito repellents, live-stock sprays, and medicine for treatment of mosquito bites. The total cost of controlling irrigation mosquitoes, together with the other serious economic losses they cause, runs into many millions of dollars each year. Thus, mosquitoes are a major economic liability in many irrigated areas.

NATURE AND EXTENT OF VECTOR PROBLEMS

Vector problems primarily concern mosquitoes and their biology; however, other aquatic insects, terrestrial arthropods, or rodents are sometimes involved.

Biology of Mosquitoes

This discussion is intended to provide only basic information concerning some of the more pertinent biological characteristics of mosquitoes commonly associated with water resource developments. These mosquitoes represent 4 important genera or groups: *Anopheles*, *Culex*, *Aedes*, and *Psorophora*. All mosquito species have 4 distinct stages in their life cycle: the egg, the larva ("wiggler"), the pupa ("tumbler"), and the adult (Fig. 1). A characteristic common to all mosquitoes is that they live in water continuously from the time the eggs hatch until the adults emerge. The aquatic stages generally occur in shallow water with an abundance of vegetation and flogage and where they are protected from wave action. They do not occur in the deep open waters of lakes, ponds, or streams.

On the basis of egg-laying habits, mosquitoes may be divided into temporary-water and permanent-water species. The *Aedes* and *Psorophora* are temporary-water breeders which deposit their eggs on the moist soil of areas where surface water has receded. Hatching of the eggs is stimulated by subsequent floodings. The eggs may remain dormant for long periods, sometimes for several years if conditions are unfavorable for hatching. Normally, the eggs hatch more or less simultaneously soon after they are flooded. In contrast, the *Anopheles* and *Culex* usually lay their eggs on the surface of permanent and semi-permanent bodies of water. The eggs usually hatch within a few days after oviposition. For both the temporary-water and permanent-water

LETTER 19

mosquitoes, time between hatching of eggs and emergence of adults varies with species and environmental conditions, especially water temperature. Development of the aquatic stages may be completed in as little as 4 days in hot weather, while several weeks may be required in cool weather. Aedes and Psorophora mosquitoes generally develop more rapidly than the Anopheles and Culex.

Adult mosquitoes mate soon after emergence, and the females begin seeking blood meals, which most species require before laying eggs. The biting habits of adult mosquitoes vary with species. Anopheles and Culex mosquitoes feed mainly at night, while Aedes and Psorophora species feed both at night and in the daytime. Most species exhibit a peak of biting activity during the 1- or 2-hour period immediately after sundown. The Aedes and Psorophora species are aggressive and vicious biters of both man and livestock. Culex tarsalis, a vector of encephalitis, feeds readily on a wide range of hosts including man, wild and domestic birds, and livestock.

The flight range of mosquitoes varies widely with species and environmental conditions. The direction and distance of travel are greatly influenced by availability of food, shelter, and wind conditions. In many areas availability of food is probably the most important factor influencing the movement of mosquitoes. Generally, if an adequate food supply is close to the production sites, adult mosquitoes will not travel far from their sources. On the other hand, mosquitoes may travel several miles when adequate food supplies are not available nearer their larval habitats. The normal flight range of the Anopheles and Culex mosquitoes was formerly considered to be about 1 mile; however, recent studies have shown that certain species such as C. tarsalis may travel several miles. Most Aedes and Psorophora species are strong fliers and are known to range several miles from their larval habitats.

Other Aquatic Insects

Several other groups of aquatic insects may be produced in habitats associated with water resource projects in sufficient numbers to create public health and economic problems. Deer flies and horse flies (Tabanidae) are produced along the margins of impoundments and in seeps and marshes in irrigated areas. These insects are vicious biters of both man and livestock and are sometimes involved in the transmission of diseases such as tularemia and anthrax. Some species of small gnats of the family Ceratopogonidae are also vicious biters and often produce severe reactions and vesicular lesions. These gnats are produced in damp areas of many irrigated valleys as well as salt marshes and other wetland areas. In certain areas, black flies (Simuliidae) plague both man and livestock with their irritating and painful bites. They are normally produced in streams but sometimes occur in large numbers in irrigation conveyance systems. The small nonbiting midges (Tendipedidae) and the phantom midges (Chaoborinae) are another group of pestiferous

insects which may be produced in impounded water. These insects are attracted to lights in tremendous numbers and cause severe human annoyance. An example is the Clear Lake gnat, Chaoborus astictopus, which creates serious problems at the resort areas in Lake County, California.

Terrestrial Arthropods and Rodents

Each summer many millions of people who visit picnic sites, campgrounds, cabins, and other water-related recreational facilities along the shores of reservoirs are often exposed to terrestrial arthropods such as ticks, mites (chiggers), fleas, and flies as well as rodents including ground squirrels, rats, mice, and chipmunks. The public health importance of these arthropods and rodents involves a number of human diseases including Rocky Mountain spotted fever, Colorado tick fever, tularemia, relapsing fever, tick paralysis, typhus, plague, bacillary dysentery, and typhoid. In addition, the bites of certain arthropods cause considerable irritation, discomfort, and annoyance.

VECTOR PREVENTION AND CONTROL IN RELATION TO THE DEVELOPMENT AND UTILIZATION OF WATER RESOURCES

Water resource projects, especially impoundments and irrigation developments, invariably create a variety of man-made aquatic habitats favorable for the production of insects of public health importance. Experience has shown that if proper consideration is given to vector problems during the initial stages of project planning, adequate provision can be made for prevention or control measures that will minimize health hazards. It is therefore essential that vector prevention and control be planned and "built into" each new project and that it be compatible with the primary functions of the project, such as irrigation, navigation, hydroelectric power, and flood control. As a basic principle, the project sponsor, whether an agency, group, or individual, should be responsible for providing adequate vector prevention and control measures for water resource developments. For public-use developments, the planning, construction, and operating agencies or groups should have this responsibility; while for private developments, the land owner and/or operator should be responsible. The determination of public health requirements, including vector prevention and control measures, is usually the responsibility of the appropriate local, State, or Federal health agencies. These agencies should provide the construction and operating agency, group, or individual with appropriate plans and specifications for vector prevention and control.

A balanced program of naturalistic and source reduction measures adapted to the overall functions of the project provides the most effective control of vector problems, and over a period of years such measures are more economical than repetitive control measures.

LETTER 19

Chemical control measures are often needed to supplement these measures because the water in certain types of aquatic habitats, such as rice fields, obviously cannot be eliminated. Likewise, other types of vector sources may be reduced in size but not completely eliminated. Insecticides are also employed to provide temporary control in emergency situations, such as encephalitis outbreaks. Chemical control in some sections of the country has been complicated by the fact that certain vector species have developed high levels of resistance to the chlorinated hydrocarbon and organophosphorus insecticides. The selection of an insecticide and its method of application should be based upon careful evaluation of a number of factors including cost, effectiveness, size and type of area to be treated, and its toxicity to fish, wildlife, domestic animals, and humans.

Vector problems associated with impoundments and the methods for solving these problems are usually different from those related to irrigation. These two types of water resource developments are the most important from the standpoint of vector problems and are discussed separately in the following sections. The discussions are limited primarily to the prevention and control of mosquitoes, the most important group of aquatic vectors associated with impoundments and irrigation. Many of the prevention and control measures for mosquitoes are equally effective against other aquatic vectors.

Mosquito Prevention and Control for Impoundments

Man-made impoundments range in size from large reservoirs covering thousands of acres to small farm ponds of less than an acre. Among the various types are multipurpose reservoirs built for power generation and/or flood control, navigation, irrigation, and related uses; municipal and industrial water supply impoundments; recreational lakes; fish and waterfowl impoundments; floodwater detention reservoirs; log storage ponds; farm ponds; and waste stabilization lagoons.

Mosquito-producing conditions are basically similar for the various types of impoundments but may vary greatly in magnitude. These conditions include emergent vegetation and/or floating debris in shallow water areas which are protected from wave action; undrained depressions, borrow pits, sloughs, marshes within the summer fluctuation zone, and rising or constant pool levels which cause the water to remain in the marginal vegetation for extended periods during the mosquito production season. It is almost axiomatic that reservoirs and ponds which are free of vegetation and flottage do not produce mosquitoes.

Malaria mosquitoes, *A. quadrimaculatus*, are frequently produced in impoundments which have protected shallow water areas with emergent vegetation and flottage. Such habitats may also produce several species of Culex mosquitoes, such as *C. tarsalis*, which like the *Anopheles* deposit their eggs on the surface of the water. Several species of

Aedes and *Psorophora* mosquitoes, which deposit their eggs on moist soil, are produced in marginal areas of reservoirs and ponds that have fluctuating water levels. *Aedes vexans* is one of the most common and widespread of these species.

It is often difficult to control mosquito production on impoundments which are not properly prepared prior to impoundage. The principal pre-impoundage measures for mosquito control include clearing of the basin; removal of vegetation from the fluctuation zone; and drainage for depressions, sloughs, and marshes within the summer fluctuation zone. Permanent shoreline improvement measures such as deepening and filling have been very effective in preventing mosquito production on TVA reservoirs throughout the Tennessee Valley. In order to preserve the effectiveness of permanent preventive measures, it is essential that reservoirs and ponds be properly maintained after they have been impounded. Of paramount importance is the fact that maximum mosquito control benefits from water level management can be realized only when impoundments have been properly prepared and maintained. Several phases of water level control, particularly flood surcharge, constant level pool, cyclical fluctuation, and/or seasonal recession can sometimes be adapted to various types of impoundments in order to minimize conditions favorable for mosquito production. A particular phase may be used to control vegetation and flottage which is favorable for mosquito production, or it may be used primarily to destroy mosquito larvae.

Conflicts sometimes arise between fish and wildlife conservation and mosquito control interests. They are frequently related to drainage and the use of insecticides and occasionally concern water level management and vegetation control (reservoir clearing). Experience with TVA impoundments has demonstrated that fish and wildlife conservation and mosquito control interests are not always antagonistic and that a cooperative approach to problems often results in the development of mutual benefits. As a general principle, wildlife conservation areas that have a high mosquito production potential should not be located within flight range of recreational areas or other human population centers.

Recreational areas, especially those with facilities for overnight occupancy, should be located along sections of the reservoir which have the lowest aquatic vector production. In selecting recreational sites, proper consideration should also be given to terrestrial vector problems. Thus, site selection for recreational areas should be based on a careful analysis of both aquatic and terrestrial vector problems. When necessary, full provision should be made for the prevention and control of both types of vector problems.

LETTER 19

Mosquito Prevention and Control for Irrigated Areas

Some of the most rapid expansion in water resources development in recent years has been in the field of irrigation. This is particularly true in the 17 Western States where the total acreage of irrigated land increased from 17 million acres in 1939 to more than 30 million acres in 1959. Even in the East, supplemental irrigation is expanding rapidly. The rapid expansion in the development of irrigation, particularly in the West, has been accompanied by proportionate increases in the production of mosquitoes which are now creating serious public health problems in many areas.

Experience has shown that man-made aquatic habitats are usually responsible for excessive mosquito populations in irrigated areas. Natural mosquito sources occur in most irrigated areas, but usually the man-made sources are by far the most important. Mosquito production occurs in both "on-field" and "off-field" aquatic habitats. Conditions favorable to mosquito production are caused by poor irrigation and drainage practices including inadequate seepage prevention and control measures; poor land preparation; use of field layouts and irrigation methods that do not fit land, crops, and water supply; application of water in excess of crop requirements; inadequate drainage systems for removal and disposal of waste water; and poor maintenance of distribution and drainage systems. Mosquito sources on irrigated fields have been found to occur most often on fields used for pastures, hay meadows, and other close-growing forage crops on which water is frequently ponded long enough for mosquito larvae to mature. The greatest total acreage of "on-field" mosquito production for the entire West probably occurs on irrigated pastures, wild hay meadows, and rice fields. The major "off-field" mosquito sources include marshes, roadside ditches, borrow pits, wasteland, and various other undrained areas which are flooded by seepage and waste irrigation water.

The faulty irrigation and drainage practices that create man-made mosquito sources also result in serious soil and water problems such as excessive water losses, waterlogging, salt and alkali accumulations, damaged soil structure, leaching of plant nutrients, soil erosion, and reduced crop yields. The ultimate solution to mosquito problems associated with irrigation must be based upon source reduction measures which are aimed at preventing, eliminating, or reducing mosquito-producing areas. Practical measures for preventing and eliminating mosquito production associated with irrigation involve the use of good conservation practices which insure high crop yields without excessive water losses or decreased soil productivity. Experience has shown that the agricultural benefits derived from these practices usually greatly exceed the cost of applying them. The prevention and control of mosquitoes and mosquito-borne diseases is an additional benefit which greatly strengthens the justification for using good irrigation and drainage practices.

Local Considerations in Vector Control

Almost every State has statutory provisions concerning the correction of nuisances or health hazards associated with insanitary conditions. Under these statutes, the abatement of public health problems associated with mosquitoes, flies, and other vectors is usually implied although it is not always specifically expressed. Most State and local health departments have general rules and regulations which may be used for the correction of public health hazards caused by various vectors. Effective regulation is generally provided when the extent of the problem is limited, when there are only a few violations, and when the property owners are able to undertake the necessary corrective measures. However, specific legislation is usually required for the prevention and control of serious problems that extend over large areas, such as mosquito problems in irrigated areas in the West.

Some 12 States in the South Central and Southeastern part of the Nation have adopted specific regulations that govern the conditions under which water may be impounded in order to minimize danger to public health. In most States, these regulations provide for reservoir clearing, drainage of marginal depressions, and periodic removal of vegetation after impoundage. Provision is also made for water level fluctuation and other supplemental control measures in several States. The regulations concerning impounded water were originally adopted for the control of malaria vectors; however, some States are broadening them to include other mosquitoes.

In recent years the need for specific legislation, authorizing formation of local mosquito control districts, has been recognized in many States throughout the Nation. Approximately half of the States now have legislation authorizing the establishment of county or district mosquito control organizations. This type of legislation has the advantage of permitting communities to meet local problems by organizing control programs that may be carried out on an area-wide basis. Such legislation has been found to be especially desirable in States where extensive mosquito problems occur, such as those associated with salt marshes and irrigation.

Vector Control Activities of Various Agencies

As previously indicated, various governmental agencies at the Federal, State, and local level are now concerned with vector control. The nature and scope of vector control activities carried out by these agencies, particularly those relating to water resource developments, are discussed in the following section.

Federal Agencies. Although all Federal development and/or operating agencies have an interest in safeguarding public health as related to their projects and programs, the consideration given to vector control

varies. Vector control programs of the Federal agencies may include the following types of activity: surveillance, research, technical assistance, and vector control operations.

The most extensive mosquito control operations have been carried out by the Tennessee Valley Authority and the U. S. Army Corps of Engineers on their impoundments. Emphasis has been given to the control of vectors of disease, particularly malaria mosquitoes (*Anopheles quadrimaculatus*).

The U. S. Public Health Service is responsible for developing and recommending procedures for the prevention and control of mosquitoes and other arthropods of public health importance associated with Federal water resource projects. In carrying out this responsibility, proposed plans for Federal water resource projects are studied to determine applicable vector prevention and control measures for incorporation into the design and construction of the project as well as control measures which should be used after the project is in operation. This activity is carried out in close cooperation with State health agencies, and the vector prevention and control recommendations are submitted jointly by the U. S. Public Health Service and the health department of the State in which the project is located. Because of limited funds and personnel available for this activity, vector evaluations and control recommendations usually are developed from an office review of the proposed plans, and field investigations are carried out on relatively few of the projects.

The Public Health Service also conducts investigations on the ecology and epidemiology of vector-borne diseases for the purpose of developing more effective vector prevention and control measures. A few studies have been conducted to determine the nature and extent of water resource vector problems, and to develop and field test chemical and source reduction measures for the control of encephalitis and other irrigation mosquitoes. Source reduction studies carried out on irrigated hay meadows in Montana in cooperation with the Soil and Water Conservation Research Division, Agricultural Research Service, U. S. Department of Agriculture (USDA) were of particular importance. These investigations showed that improved soil and water management practices for certain types of irrigated hay meadows would eliminate mosquito production and increase crop yields 5- to 10-fold.

The Entomology Research Division of the Agricultural Research Service, USDA, carries out extensive research on agricultural insects. However, a branch of the Entomology Research Division is also concerned with investigations on insects affecting man and animals, and it devotes major attention to chemical control measures for mosquitoes, lice, and ticks.

The U. S. Fish and Wildlife Service has cooperated with mosquito control agencies in conducting research on mosquito breeding problems and in developing satisfactory solutions. The Service has conducted

pilot studies on the use of impoundments as a control measure for salt-marsh mosquitoes.

State Health Agencies. The State health departments in most States carry out some type of vector control activities, usually in conjunction with their environmental health programs. Agencies other than health departments have full responsibility for vector control in several States; and in a few cases, the responsibility is divided among several agencies. Vector control activities in the States vary widely depending upon the nature and extent of existing problems. They may include vector surveys; research on chemical and source reduction measures; educational, training, and promotional activities; technical assistance on vector problems; and in some cases participation in actual control operations.

Interests of the State departments of health in the prevention and control of insects of public health importance associated with water resource projects parallel those of the U. S. Public Health Service. In the past, several State departments of health, particularly those in the Southeast, have carried out a wide range of activities in connection with the control of malaria associated with impounded water. These activities have been greatly reduced in most States in recent years. Many States are now expressing considerable concern over the current expanding magnitude of vector problems associated with water resource developments. Most States, especially those in the West where extensive irrigation mosquito problems have developed, can only provide technical assistance on a limited part-time basis. The Bureau of Vector Control, California State Department of Public Health, employs a biologist to devote full time to vector problems associated with water resource developments. This is believed to be the only State that provides full-time technical assistance on this problem. Research activities are likewise extremely limited in most States. Two exceptions are California and Florida, both of which are carrying out various types of investigations related to the prevention and control of vector problems associated with water resource developments.

REQUIREMENTS FOR PROVIDING ADEQUATE PREVENTION AND CONTROL OF VECTOR PROBLEMS ASSOCIATED WITH WATER RESOURCE DEVELOPMENTS

The nature, extent, and importance of vector problems commonly associated with water resource developments and the basic prevention and control measures for these problems have been discussed in previous sections of this pamphlet. In order for maximum benefits to be derived from the Nation's water resources, the vast backlog of vector problems associated with existing developments must be brought under control as rapidly as possible, and adequate prevention and control measures must be planned and "built into" all future projects. The basic requirements for accomplishing these objectives are:

LETTER 19

1. The agencies and groups concerned with the development and utilization of water resources, especially Impoundments and Irrigation, should have a basic knowledge of the importance of vector problems and their relation to water resource projects. In addition, they should recognize the need for coordinating and integrating vector prevention and control with the primary project functions during the planning, construction, and operational phases of their projects.
2. The sponsoring and operating agencies should accept full responsibility for the prevention and control of vector problems created by their projects.
3. The appropriate Federal, State, or local health agency should provide the construction and operating agency, group, or individual with detailed plans and specifications for vector prevention and control for individual water resource projects. The appropriate Federal, State, or local water resource agency should be responsible for seeing that the vector prevention and control measures are integrated into the project.
4. There should be continuous and close liaison and cooperation between the public health agencies and those concerned with the development and utilization of water resources.
5. For all Federal projects, legislation authorizing or providing appropriations for project construction and/or operation should provide adequate funds for building vector prevention measures into the projects at the time of planning and at the time of construction as well as funds for carrying out the necessary control measures after the project is in operation. Similar provision should be made for financing vector prevention and control measures for projects constructed and operated by State or local agencies. Administration of these funds for the specified purpose should be a designated responsibility of the project sponsor and/or operating agency.
6. Investigations should be made of possible ways and means whereby State or Federal agencies could provide additional financial assistance to local vector control programs, particularly for those areas which have sparse human population but extensive and widespread vector problems associated with irrigation or other water resource developments.
7. The irrigation and agriculture agencies should intensify their efforts to develop improved irrigation and drainage practices and to get them into use. At present, there is a tremendous gap between existing knowledge of good soil and water management practices and the application of this knowledge on irrigated farms. All-out efforts should be made to close this gap as rapidly as possible, thereby eliminating mosquito sources, conserving water, and improving irrigation agriculture. Personnel of health agencies and local mosquito control organizations should cooperate in this effort.
8. In connection with the development of vector prevention and control measures for Federal water resource projects, there is a great need for a sound and effective program providing for (a) detailed field surveys and evaluations of vector problems associated with all proposed Federal water resource projects and the development of appropriate measures for preventing and controlling these problems; (b) adequate technical assistance to Federal, State, or local agencies on the control of vector problems arising from operating water resource projects; (c) adequate surveillance and followup surveys on the prevention and control measures which have been recommended for various types of projects; (d) close and continuous liaison with all other Federal agencies concerned with the development and utilization of water resources; and (e) research as needed to develop more effective vector prevention and control measures.
9. A major increase in research activities is urgently needed to solve the current backlog of vector problems associated with water resource developments and the new problems which are constantly arising. For some types of vector problems, it will be necessary to conduct investigations in the particular area in which they occur. Others may be solved by studies in representative areas and the results can be generally applied to comparable areas. Since many of the vector problems associated with water resource projects involve both public health and other interests, they can best be solved through joint investigations by the agencies concerned. Through such cooperative research, it will be possible to mutually accomplish the major objectives of the various groups.

GENERAL RECOMMENDATIONS

In order to minimize public health hazards associated with water resource developments, every possible effort should be made to avoid creating conditions which will increase populations of vectors of public health importance. It is therefore recommended that the following principles and practices for prevention and control of vector problems be adhered to in the design, construction, operation, and maintenance of water resource projects.

Impoundments

Practices leading to the prevention and source reduction of mosquito and other aquatic insect breeding sites include the following:

LETTER 19

5. As a general principle, waterside recreational areas, particularly those which have facilities for overnight human occupancy, should be located along sections of the reservoir which have a low production potential for mosquitoes and other aquatic insects of public health importance.

Terrestrial Arthropods and Rodents at Recreational Areas

1. Proper storage, collection, and disposal of refuse should be practiced in order to prevent and control flies, wasps, other noxious insects, rats, wild rodents, and other small mammals.
2. All buildings should be rodentproofed at recreational areas where rodents are prevalent which may create public health hazards.
3. Debris, rubbish, and other materials which may serve as harborage for rodents and other small mammals should be removed periodically.
4. Brush and weeds along paths, trails, roadways, and other areas frequently used by visitors should be removed in order to reduce the likelihood of tick infestation.

Waterfowl Refuges

1. Whenever possible, sites selected for waterfowl habitat development should not be within mosquito flight range of population groups or recreational areas.
2. Waterfowl areas which are to be flooded during the mosquito season should be diked or otherwise prepared with steep shorelines to preclude shallow water areas favorable for mosquito production.
3. Provision should be made for water level management in waterfowl areas which will minimize mosquito production.

Irrigation

Project Conveyance and Distribution Systems

1. Lining or other satisfactory seepage control measures should be provided for all sections of canals and laterals located in porous soil where excessive leakage would result in waterlogged areas, seeps, and ponds.
2. Drains should be installed to prevent ponding of excess irrigation water and natural runoff along the upper side of canals and laterals. All drainage crossing or inlet structures should be placed on grade to avoid ponding.

17

1. All borrow pits and other potential ponding areas associated with construction of the dam, relocation of highways or roads, etc., which are located above maximum pool level should be made self-draining.

2. Prior to impoundage, the reservoir basin should be prepared as follows:

- a. The normal summer fluctuation zone of the permanent pool should be completely cleared except for isolated trees and sparse vegetation along abrupt shorelines which will be exposed to wave action.
- b. Dense stands of timber rooted below the normal summer minimum pool level but extending above that level should be cleared. In some situations, such timber may be felled and securely tied down in lieu of disposal.
- c. Borrow pits, depressions, marshes, and sloughs which will be flooded by the reservoir at maximum pool level and which would retain water at lower pool levels should be provided with drains to insure complete drainage or fluctuation of water within them.
- d. If the summer fluctuation zone of the permanent pool is limited to a few feet, consideration should be given to "building out" mosquito-producing areas located within flight range of population groups or recreational areas through the use of measures such as deepening and/or filling. This would minimize the need for repetitive measures for controlling vegetation and mosquito production.

3. After impoundage, the following maintenance measures should be carried out in all potential mosquito-producing areas located within flight range of human population groups or recreational areas frequented by significant numbers of persons:

- a. All dense vegetation should be removed periodically from flat, protected areas within the normal summer fluctuation zone of the permanent pool.
- b. Vegetation, debris, and flotsam should be removed periodically from all drains to insure free flows.
4. Water level management to minimize conditions favorable for mosquito production should be used to the maximum degree permitted by the primary purposes of the reservoir. This will minimize the need for repetitive measures for controlling vegetation and mosquito production.

16

LETTER 19

3. Borrow areas should be self-draining to keep them from retaining ponded water.
4. When possible, provision should be made to prevent turn-outs and other hydraulic structures from retaining residual water when they are not being used.
5. Effective measures should be provided to prevent ponding of leakage from water control structures.
6. Every effort should be made to establish delivery schedules which will provide farmers with adequate but not excessive amounts of water at proper intervals to insure efficient irrigation of the crops concerned.
7. Vegetation and debris which would retard normal flows should be periodically removed from conveyance channels, water control structures, and drains.

Project Drainage Systems

1. Trunk drainage systems should be installed to insure complete removal and proper disposal of excess irrigation water, natural runoff, and seepage from both irrigable and nonirrigable lands affected by the distribution and use of irrigation water on the project.

2. Drainage ditches should be designed, constructed, and maintained so as to minimize ponding in the channels and to insure free flows at all times.

3. Provision should be made to prevent water from ponding behind spoil banks.

4. Underdrains, culverts, inlets, etc., should be placed on grade to prevent ponding.

Irrigated Farms

1. The sponsoring agency and other organizations concerned with irrigation agriculture or mosquito control should encourage irrigation farmers to use the following irrigation and drainage practices which will prevent or minimize mosquito sources:

- a. The farm supply system, drainage system, and field layouts should be properly fitted to the topography, soil, water supply, crops to be grown, and irrigation methods to be used.

Farm Ponds

1. The pond basins should be cleared of trees, brush, and other dense vegetation prior to impoundage.
2. Ponds should be constructed with steep banks to discourage growth of vegetation.
3. All dense vegetation should be removed periodically from shallow water areas.

Channel Improvements and Drainage

1. Borrow areas resulting from construction of the project should be made self-draining.
2. Material excavated from channels should be disposed of in such a way that it will not result in ponding of water.
3. Adequate drains should be installed to prevent ponding of water on berms or behind spoil banks, levees, and dikes.
4. Drainage ditches should be designed, constructed, and maintained so that they will concentrate low flows and reduce silt deposition and subsequent ponding, thereby insuring free flows at all times.
5. Underdrains, culverts, inlets, etc., should be placed on grade to prevent ponding.
6. Collection sumps should be constructed with steep side slopes, and any emergent vegetation should be removed periodically.
7. Sections of natural drainageways that are cut off or bypassed by new channels should be filled or provided with adequate drains.

LETTER 19

8. Interior drainage facilities should be well maintained to avoid excessive ponding.

Waterways, Terraces, Floodways, Diversion Channels, and Drainage Ditches

1. Waterways, terraces, floodways, diversion channels, and drainage ditches should be designed, constructed, and maintained so that they will not retain ponded water or create ponded areas outside of the channels which would be suitable for mosquito production.

Supplemental Chemical Control Measures

In situations where adequate vector control is not obtained through prevention and source reduction measures, provision should be made for supplemental use of insecticides and rodenticides to achieve the desired level of control.

Routine Vector Appraisal

Arrangements should be made for carrying out a routine program of vector appraisal as a part of normal operations of the reservoir and associated recreational areas. Inspections for adult and larval mosquitoes and other vectors are essential for planning and evaluating control measures and for adjusting control programs to meet temporary or emergency situations.

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HIGHWAY DESIGN AND CONSTRUCTION CRITERIA FOR PREVENTION AND CONTROL OF MOSQUITO PRODUCTION

I. General Statement:

The prevention and control of mosquito production resulting from highway construction can largely be achieved by good design, construction and maintenance practices. The following criteria for highway construction to prevent mosquito production may not be all-inclusive but will serve to guide engineering planning and design. While in certain instances excessive costs resulting from adverse terrain or type of construction materials available may preclude rigid adherence to the criteria, in general, it is considered that good construction practices would normally embody most of these measures.

II. Roadbed

A. During construction of the roadway, the roadbed should be maintained in such condition that it will be well drained at all times.

B. Mulching or seeding of surfaces exposed to erosion is desirable.

III. Borrow Pits

A. Borrow pits should be self-draining.

B. Borrow pits should be located and constructed in such a manner that irrigation water or surface drainage will not collect in them. The use of roadside borrow pits and ditches for irrigation canals or waste-ways should not be permitted.

C. The following criteria should apply for borrow pits not self-draining:

- ✓ 1. The sides should be sloped as steeply as the soil type will permit, but should not exceed 2 horizontal on 1 vertical.
2. Where practicable, the minimum water depth should be 3 feet.
3. Consideration should be given to introduction of fish as a mosquito control measure, after consultation with the State fish and game agencies.

IV. Ditches

A. Ditches should be adequately designed to drain borrow areas, roadside, and road surfaces.

✓ B. Wide ditch sections should be "V" or "U"-shaped to concentrate low flows.

C. Vegetation control should be accomplished as necessary to keep ditches free flowing.

LETTER 19

V. Culverts

A. Culverts should completely drain the upstream side. This may not be practicable when road is located adjacent to a reservoir. Avoid flat or nearly flat ditch gradients along back slopes which contain seepage areas.

B. Where culvert standpipes are used to prevent erosion, the standpipes should be perforated and surrounded by a gravel cone to completely drain the area.

C. Design culvert so that both ends are in the natural channel wherever possible.

D. Provide rock or concrete apron at inlet and outlet of culvert where necessary to prevent erosion or scour of streambed.

E. It is desirable to clean stream channels of brush and debris above culverts for at least 50-100 feet, preferable by hand, to prevent clogging. Natural barriers should not be removed.

F. The minimum recommended gradient for a culvert is 0.1 percent.

VI. Catch Basins

A. Catch basins and manholes should be planned so that no water will be ponded in them.

(copy)



STATE OF MONTANA
ENVIRONMENTAL QUALITY COUNCIL
 CAPITOL STATION
 Helena, Montana 59601

TO: DIRECTOR, ENVIRONMENTAL QUALITY COUNCIL

FROM: MONTANA
 DATE: 9/19/78
 SUBJECT: SODIC SOILS

RE: MONTANA
 DATE: 9/19/78
 SUBJECT: SODIC SOILS

LETTER 20

Telephone (406) 443-3742

September 19, 1978

Director
 U. S. Geological Survey
 National Center, Mail Stop 108
 Reston, Virginia 22092

Dear Sir:

The Spring Creek Mine's Environmental Impact Statement is one of the most adequate assessments, environmentally speaking, that I have had the opportunity to read. Although there are some areas of question, the statement presents the pertinent problems and honestly predicts the impacts that will occur. It is now up to the lead agency to review this document in detail and to realize the implications of the impending impacts and the precedent that may be set however the direction of its decision.

The major environmental impact concerns are the predominately saline sodic soils, the establishment of a diversified vegetative mosaic over these soils and the wildlife or domestic stock utilization of the area. The EIS explains the severity of the saline sodic soils on page III-10 and further states on page III-12 that unless highly technical and expensive reclamation efforts are utilized that a combination of saline and sodic spoils will render reclamation efforts ineffective. On page V-1 it is stated that the "sodic condition of the soil further increases the instability of the land surface and that the combination of sodic and saline spoils would impede reclamation unless intensive management were undertaken." On page VIII-38 there is a statement that says, "estimates to insure the integrity of the reclaimed surface so that it can be demonstrated that the area is as stable as adjacent areas, and can be used in the same manner may range from decades to centuries."

The EIS specifically points out the intensive use of the area by wildlife. These animals will be greatly reduced by the mining and will remain in a reduced condition until the land is returned to similar previous conditions.

Domestic livestock use of the land will also be impeded for the duration of time that it takes for complete reclamation.

Other impacts that will probably occur over a long period of time due to slow soil stabilization are wind and water erosion, stream sedimentation which will reduce water quality, and reduced air quality generated from dust.

Your comments have been noted.

LETTER 20

U.S. Geological Survey
September 19, 1978
page two


As I have previously stated, the decision promulgated from this EIS is important. If the lead agency decides to grant the permit I hope it is specified in the decision the importance of a full and complete reclamation effort, no matter the expense. If this effort is not insured in the decision, this mining permit and other permits may be issued with the land suffering in the end. When the land suffers so does animal life and eventually the human community.

I have one comment that deals with the content of the EIS. On subjects where an unknown amount of impact is generated a "worst case analysis" should be utilized. Specific examples where the "worst case" could be applied are on page III-1, the second paragraph under "Topography and Geomorphology"; page III-2, the second and third paragraphs on the page under the above topic; page III-2, the third paragraph under "Paleontology"; page III-3, the first paragraph under "Surface Water"; and on page III-5 the first paragraph. These are some examples of where the analysis could be used. I would like to see this analysis applied wherever there is an unknown impact involved.

Thank you for this opportunity to comment.

Sincerely,

TERRENCE D. CARMODY
Executive Director

By 
Duane Noel
Ecology Researcher

TDC/DN/mb



LETTER 21

MONTANA HISTORICAL SOCIETY

225 NORTH ROBERTS STREET • (406) 449 2694 • HELENA, MONTANA 59601

August 24, 1978

Mr. Craig Howard
 Spring Creek Mine Coordinator
 Department of State Lands
 1625 11th Avenue
 Helena, Montana 59601

RE: Spring Creek Mine

Dear Mr. Howard:

Thank you for submitting a copy of the Draft Environmental Statement on the Proposed Mining and Reclamation Plan, Spring Creek Mine.

Your draft reflects the fact that Executive Order 11593, and Section 106 of the Historic Preservation Act, compliance are not yet complete. For this reason, I cannot comment at this time.

This office is coordinating with the Miles City District, Bureau of Land Management to assure compliance with laws protecting cultural resources. I will keep you posted on the progress.

Thank you.

Sincerely,

Ken Roberts
 State Historic Preservation Officer

KK:EV:rgb

cc: State Clearinghouse
 Glenn Malinberg, Federal Task Force Leader
 U. S. Geological Survey
 Post Office Box 1135
 Billings, Montana 59103

See response to letter 1-A.

LETTER 22



WYOMING
EXECUTIVE DEPARTMENT
CHEYENNE

ED HERSCHLER
GOVERNOR

November 14, 1978

Mr. Glenn Malmberg
Federal Task Force Leader
U.S. Geological Survey
P.O. Box 1135
Billings, Montana 59103

Re: Spring Creek Mine - Northern
Energy Resource Company
Draft Environmental Statement

Dear Mr. Malmberg:

Enclosed are comments received by the State Planning Coordinator's Office. Upon receipt of additional comments relative to the above draft statement, this office will forward them to you.

Thank you for the opportunity to review the draft statement. Please notify this office of any further progress on the project.

Sincerely,

A handwritten signature in cursive script that reads "Dick Hartman".

Dick Hartman
State Planning Coordinator

DH:co



OF WYOMING

Wyoming State Highway Department

P O. BOX 1708

CHEYENNE, WYOMING 82001

LETTER 22

Edna S. H. Go. and
Lena Menghin, Superintendent and Chief Engineer

M E M O R A N D U M

October 3, 1978

TO: State Planning Coordinator,
Wyoming State Clearinghouse
2320 Capitol Avenue, Cheyenne, Wyoming 82002

FROM: William P. King, P. E., Environmental Services Engineer *WPK*

SUBJECT: Comment on Draft E. I. S. for the Proposed Mining and
Reclamation Plan for Spring Creek Mine near Decker, Montana
State Identifier Number 78-117 D

The impacts on Wyoming's transportation system caused by this mine are not significant by themselves. However, the cumulative effect of this and other mines that rely on Wyoming's transportation system are causing ever worsening problems.

Presently, there is an average daily traffic of 1,400 vehicles on Wyoming Highway 338, and new mines proposed in Wyoming would increase this to approximately 2,500 vehicles by 1989. The road is not designed to handle this amount or type of traffic. It needs to be reconstructed, widened, and all structures replaced.

Rail traffic is also a major cumulative concern. There is now considerable public pressure to provide a railroad separation on Wyoming Highway 336 at WYarno (Dutch in the E. I. S.). Here, Highway 336 crosses the railroad on the "we" connection, crossing both legs of the "we". There will be switching involved and we doubt that trains will pass at 50 mph, thus lengthening the time of crossing blockage.

In addition, the Burlington Northern Railroad splits communities it passes through. While the larger communities have at least one separation, there are several at-grade street crossings. Also, the at-grade crossings are better located to serve intercommunity travel. Consequently, the ever-increasing number of trains is causing severe impacts.

Public agencies who have jurisdiction over the affected roads and streets are frustrated in their efforts to alleviate these problems because the needs are increasing faster than the agencies' abilities to finance the public improvements.

Your comments have been noted.

**NORTHERN ENERGY
RESOURCES COMPANY**
529 SW THIRD AVENUE
PORTLAND, OREGON 97204
TELECOPIER 503-243-4319
TELEPHONE 503-243-4435

LETTER 23



October 13, 1978

WILLIAM W. LYONS, VICE PRESIDENT

Director
U. S. Geological Survey
National Center
Mail Stop 108
Reston, Virginia 22092

SUBJECT: Comments on Draft Environmental Statement
for Proposed Mining and Reclamation Plan,
Spring Creek Mine, Big Horn County, Montana

Dear Sir:

The purpose of this letter is to forward comments on the Draft Environmental Statement for the Proposed Mining and Reclamation Plan for the Spring Creek Mine, Big Horn County, Montana. These comments have been prepared, and are presented, in behalf of Spring Creek Coal Company by NERCO, Inc. (dba Northern Energy Resources Company), Spring Creek Coal Company's corporate parent.

Subsequent to submittal of its original Mining Permit Application, Spring Creek Coal Company modified its mining and reclamation plan. This modification took the form of a reduction in the area to be affected by proposed mining operations pending the completion of exhaustive hydrologic and other studies in the excluded areas. It is important to note that the area covered by the modified mining and reclamation plan is fully enclosed within the area covered by the original plan and that exclusion of the study areas reduces the impacts described in the Draft Environmental Statement. The modified mining and reclamation plan is fully described in the amended Mining Permit Application submitted to the Montana Department of State Lands, the U. S. Geological Survey and the Office of Surface Mining on August 11, 1978, and is adequately summarized as the "Central Field Mine Plan" in the DES chapter entitled "Alternatives to the Proposed Action" (Chapter VIII, Section E).

LETTER 23

Director
U. S. Geological Survey
October 13, 1978
Page Two

Because many of the environmental impacts envisioned by the drafters of the Draft Environmental Statement have been reduced or eliminated under the modified mining and reclamation plan (copies of which have been delivered to the EIS task force), the enclosed comments have been directed more towards areas not addressed by the modifications.

In all respects, Spring Creek Coal Company and NERCO believe they have developed a thoroughly sufficient mining and reclamation plan which provides for the environmentally sensible extraction of this much-needed energy resource and which fully complies with all current applicable state and federal laws and regulations. We are now hopeful that preparation of the Final Environmental Impact Statement and granting of all necessary permit approvals will proceed on schedule so that coal from the Spring Creek Mine may make its contribution to the satisfaction of our national energy demands.

Yours sincerely,



W. W. Lyons

WWL/kw

Enclosure

cc: Mr. Joe Elliott
Mr. Bob Sutton

LETTER 23

COMMENTS
OF
SPRING CREEK COAL COMPANY
ON

DRAFT ENVIRONMENTAL STATEMENT
PROPOSED MINING AND RECLAMATION PLAN
SPRING CREEK MINE
BIG HORN COUNTY, MONTANA

Prepared October 11, 1978

Submitted in behalf of Spring Creek Coal Company by:

NERCO, Inc.
(dba Northern Energy Resources Company)
529 S.W. Third Avenue
Portland, Oregon 97204
503/243-4435

LETTER 23

I DESCRIPTION OF THE PROPOSED ACTIONS
B. Background and history
5. Description of the coal resource

I-13

Page

Quotation from DES.

An average of mine "as received" analyses of the coal physical and chemical properties is as follows:

Btu/pound-----	9373.
% Sulfur-----	0.35
% Moisture-----	25.06
% Ash-----	3.56
% Volatile-----	32.81
% Fixed carbon-----	38.59
% Equilibrium moisture-----	23.35
True specific gravity-----	1.31

Comment:

A Information now available to Spring Creek Coal Company makes it possible to amend this statement as follows:

An average of fifty-five "as received" analyses of the coal physical and chemical properties is as follows:

Btu/pound-----	9407.
% Sulfur-----	0.33
% Moisture-----	24.50
% Ash-----	3.63
% Volatile-----	31.83
% Fixed carbon-----	40.04
% Carbon-----	54.64
% Equilibrium moisture-----	23.40
True specific gravity-----	1.31

A See text revision, chapter I, Background and History, Description of the Coal Resources.

LETTER 23

Section affected:

- I. DESCRIPTION OF THE PROPOSED ACTIONS
 C. Proposals of the Spring Creek Coal Company
 2. Mining and reclamation
 d. Reclamation
 (2) Topsoil redistribution

Page: I-35

Quotation from DES:

...On areas where the topsoil is from a topsoil stockpile, a straw or hay mulch would be applied at a rate of two tons per acre and crimped or disced into the topsoil prior to seeding...

Comment:

B Because reclamation activities begun in the spring differ from those conducted in the fall months, this statement can be updated as follows:

...On areas where the topsoil is from a topsoil stockpile, if reclamation is begun in the spring millet will be used and if reclamation is begun in the fall a straw or hay mulch will be applied at a rate of two tons per acre and crimped or disced into the topsoil prior to seeding...

B See discussion on the Central Field Mine Plan, chapter VIII, Alter-nate Mining Plan - Central Field Mine Plan, Proposals of the Spring Creek Coal Co., Reclamation, Topsoil Redistribution and Topsoil Amendments.

This constitutes a change from the original mining and reclamation plan addressed in chapters I-VII.

LETTER 23

II. DESCRIPTION OF THE ENVIRONMENT

- A. Geology
 1. Topography and geomorphology

II-1

Page:

Quotation from DES:

Field evidence from the mine area indicates natural rates of erosion and deposition of at least 1,200 to 2,000 tons per square mile per year (David Dossett, OSM Oral Communication, 1977).

Comments:

C-1¹.

This statement appears to be in conflict with the statement on page II-10 under II.B.1.a:

"premining natural sediment yield rate is assumed to be 0.5 acre feet per square mile per year for undisturbed land (USDA, 1974)."

C-2².

In addition to the possible reasons for accelerated erosion rates of man's activities as stated in this paragraph, agricultural activity and overgrazing are also reasonable causes.

C-3³.

Sediment rates for Spring Creek depend upon several physical conditions:

- a. Spring Creek stream flows are infrequent, and to date, the monitoring program has not recorded flows. Aerial sediment yields and stream sediment loads are related to the volume of water flowing through the area.
- b. The extensive outcrops of permeable clinker along Spring Creek would decrease the sediment carrying capacity of the streams as their water volumes rapidly diminish downstream.
- c. The number of stock watering ponds on the South Fork Spring Creek would tend toward stilling basin effects, and sediment yield rates would necessarily account for the drainage areas in the reaches of streams between the ponds.

Therefore, the total sediment yield from the entire permit area would tend to be lower than if the ponds were nonexistent or if rock, other than permeable clinker, outcropped along the streams.

Please note that the figure on page II-1 of the draft EIS is an erosion estimate, while the figure on page II-10 is a sediment yield estimate.

The rate of sediment yield is always less than the rate of erosion. Sediment yield is lower because not all material eroded in a drainage unit leaves as sediment, but instead is deposited within the basin after being transported a relatively short distance. 0.5 acre-feet of sediment falls at the lower limit of the 1,200 to 2,000 tons/mi²/year range. The actual tonnage depends on the assumed bulk density of the sediments. The 1,200 to 2,000 tons/mi²/year estimate is for the actual minesite. The 0.5 acre-feet figure is a general figure for undisturbed rangeland and, therefore, cannot be applied too rigorously.

Page II-1, paragraph 2, of the draft EIS already indicates that live-stock grazing contributes to the high erosion rate. There are currently no other agricultural activities within the permit area.

It is correct that sediment rates for Spring Creek depend upon the three factors listed. However, the estimated rate of 1,200 to 2,000 tons per square mile per year refers primarily to hillslope erosion which is not dependent upon the three factors listed.

LETTER 23

Section affected:

II. DESCRIPTION OF THE ENVIRONMENT

- A. Geology
2. Stratigraphy and overburden

Page:

II-7

Reference to
DES Figure:

Figure II-4

Comment:

D The following drill holes were mislabeled on the original figure and should be relabeled as shown below:

306 should read 308
382 should read 381
318 should read 382

D Figure II-4 has been corrected.

Section affected:

II. DESCRIPTION OF THE ENVIRONMENT

- B. Hydrology
1. Surface water

Page:

II-8

Quotation from DES:

...All streams in the permit area are ephemeral; however a short reach of South Fork is perennial, due to a spring that discharges water from the alluvium...

Comment:

E Studies conducted by Spring Creek Coal Company have not established that any portion of South Fork may be regarded as a perennial stream. Though it is possible that portions of the South Fork stream bed are wetted by a perennial spring, further studies to be conducted in behalf of Spring Creek Coal Company will be necessary to confirm the presence and scope of such an area.

E See text revision, chapter II, Hydrology, Surface Water.

LETTER 23

Section affected: II. DESCRIPTION OF THE ENVIRONMENT
B. Hydrology
1. Surface water

Page: II-9

Quotation from DES: The estimated annual runoff from the Spring Creek drainage, below the confluence of Spring Creek and South Fork, is about 460 acre-feet.

Comments: **F** Spring Creek Coal Company is conducting ongoing hydrologic studies which will address, in part, the calculation of annual runoff. The conclusion that "annual runoff from the Spring Creek drainage, below the confluence of Spring Creek and South Fork, is about 460 acre-feet" is difficult to verify without knowledge of how for below the confluence this figure is deemed applicable and without knowledge of how the runoff was calculated.

Section affected: II. DESCRIPTION OF THE ENVIRONMENT
B. Hydrology
1. Surface water
b. Quality

Page: II-10

Quotation from DES: ...[S]urface water quality on the permit area is not currently known...

Comment: **G** It should be noted that the hydrology baseline water monitoring program has included the test results of sampling surface water from the permit area.

F The calculation of 460 acre-feet per year was computed at the USGS gaging station (number 06306900, at bridge 5 miles north of Decker) assuming an annual runoff of 0.25 inches. Computation was as follows:
$$34.7 \text{ mi}^2 \times 640 \text{ acre/mi}^2 \times 0.25 \text{ in/yr} = 460 \text{ acre-feet/yr}$$

This is compatible with the estimated annual runoff prior to mining projected in the Decker final environmental statement, p. 197.

G The only place where samples of flowing surface water were collected is at the perennial portion of South Fork Spring Creek. The total dissolved solids in this portion of the stream were 2,440 mg/L in April 1978 at a time when there was no flow in the South Fork at the flume 1.5 miles downstream from the sampling site. A sample collected in May had about 1,500 mg/L at a time when the flow at the flume was about 16 ft³/s. Both samples were of the sulfate type with magnesium dominating both calcium and sodium. Although water of this type is suitable for livestock and wildlife a concentration of 1,500 mg/L would constitute a "high salinity hazard" for irrigation water and 2,440 mg/L would be a "very high salinity hazard."

The numerous samples collected from stock ponds were all somewhat to very much lower in dissolved solids as compared to the stream.

LETTER 23

Section affected: II. DESCRIPTION OF THE ENVIRONMENT
B. Hydrology
2. Ground water

Page: II-11

Quotation from DES:

...The Spring Creek facility probably inhibits movement into the area from the northwest. Thus most of the ground water in the permit area probably originates from local recharge...

Comment:

It might be concluded from this statement that local recharge, of unknown extent, is the sole source of groundwater in the permit area. Ongoing studies will continue scientifically to address this subject.

Section affected: II. DESCRIPTION OF THE ENVIRONMENT
B. Hydrology
2. Ground water

Page: II-11

Quotation from DES:

...[I]t is believed that the four aquifers are hydraulically connected.

Comment:

H The hydrology section of the Environmental Baseline Study provides data to show that the Anderson-Dietz and the Canyon coal seams are not connected and are distinct aquifers.

H See text revision, chapter II, Hydrology, Ground Water.

Section affected: II. DESCRIPTION OF THE ENVIRONMENT
B. Hydrology
2. Ground water
a. Alluvial aquifers

Page: II-11

Quotation from DES:

The alluvium is recharged by infiltrating from the ephemeral streams and is discharged by water-loving plants along the streams, by downward movement into the underlying rocks, and locally by return flow to the stream.

Comment:

I A listing of the water loving plants would be necessary to properly evaluate the relationship between evapotranspiration and amount of available water.

I See text revision, chapter II, Hydrology, Ground Water, Alluvial Aquifers, and the identification of species occurring in the riparian community, Appendix F-1.

Section affected: II. DESCRIPTION OF THE ENVIRONMENT
B. Hydrology
2. Ground water
b. Anderson-Dietz aquifer

Page: II-12

Quotation from DES: ...The transmissivity is highly variable, from an amount too low to be measured to about 130 feet per day.

Comment: **J** As outlined in the hydrology baseline report, transmissivity is estimated to average 1,100 gallons per day per foot for the Anderson-Kietz aquifer. The quoted reference appears to refer to permeability.

J See text revision, chapter II, Hydrology, Ground Water, Anderson-Dietz Aquifer.

Section affected: II. DESCRIPTION OF THE ENVIRONMENT
B. Hydrology
2. Ground water
b. Anderson-Dietz aquifer

Page: II-12

Quotation from DES: The recharge to the Anderson-Dietz aquifer is largely by downward movement, mainly through fractions, from the alluvial aquifer. . . .

Comment: **K** Spring Creek Coal Company's studies would conclude that is highly unlikely that the fractures are the principal source of recharge of the coal seam from the alluvium. If this statement relates to the off-site or off-permit locations at the outcrop and burn, it should so indicate.

K See text revision, chapter II, Hydrology, Ground Water, Anderson-Dietz Aquifer.

Section affected: II. DESCRIPTION OF THE ENVIRONMENT
B. Hydrology
2. Ground water
b. Anderson-Dietz aquifer

Page: II-12

Quotation from DES: . . . [T]he water from the Anderson-Dietz aquifer is . . . similar to water from the overlying alluvium.

Comment: **L** The baseline studies have indicated that the alluvium and coal aquifer waters are reasonably distinct in quality.

L See text revision, chapter II, Hydrology, Ground Water, Anderson-Dietz Aquifer.

LETTER 23

Section affected:

- II. DESCRIPTION OF THE ENVIRONMENT
 B. Hydrology
 2. Ground water
 c. Clinker aquifer

Page:

II-12

Quotation from DES:

... [I]n many places [water from the clinker aquifer] is the best quality ground water in the vicinity.

Comment:

M The clinker is essentially dry in the northeast portion of the permit area. Consequently, analyses of ground water in the clinker are unavailable due to insufficient quantities for testing. Clinker in the southeast part of the permit area is also dry. The results of test drilling have also indicated insufficient quantities of water for testing.

M See text revision, chapter II, Hydrology, Ground Water, Clinker Aquifer.

Section affected:

- II. DESCRIPTION OF THE ENVIRONMENT
 B. Hydrology
 2. Ground water
 d. Canyon aquifer

Page:

II-13

Quotation from DES:

... [W]ater quality [in the Canyon aquifer] is not known.

Comment:

N Water quality testing of the Canyon coal aquifer has been completed and results indicate that the water is similar in quality to the Anderson-Dietz coal aquifer in the permit area. The test results have been summarized in Table 3, page II-22 of Amendment to the Mining Permit Application, dated August 10, 1978.

N See text revision, chapter II, Hydrology, Ground Water, Canyon Aquifer.

LETTER 23

Section affected: II. DESCRIPTION OF THE ENVIRONMENT
E. Soils
1. The soil resource

Page: II-21

Quotation from DES: By contrast, uniform areas reclaimed after mining, such as those at West Decker and Colstrip, do not support the diverse life forms represented in the permit area.

Comment:

O It should be noted that plant diversity in a reclaimed community is dependent upon the seeding mixture. The revised seeding mixture for Spring Creek, as discussed in Amendment One to the Mining Permit Application, provides for much greater diversity than exists at either West Decker or Colstrip. Spring Creek Coal is confident that these species can be established at the Spring Creek Mine and has committed itself to an active program of continuing research.

O Literature devoted to the problem of plant cover establishment on mined lands suggests that there is more to establishing diverse plant communities than simply including the seeds in a seeding mix. Establishing a diverse climax community is very difficult and depends on far more than simple changes in seed mixture.

Section affected: II. DESCRIPTION OF THE ENVIRONMENT
F. Vegetation
1. Vegetation mozaic
b. Scrub

Page: II-30

Quotation from DES: ... Soil moisture conditions are quite good throughout the growing season.

Comment:

P It might be helpful to cite authorities for this statement since ongoing studies being conducted in behalf of Spring Creek Coal Company have not confirmed this finding.

P See text revision, chapter II, Vegetation, Vegetation Mosaic, Scrub.

LETTER 23

II. DESCRIPTION OF THE ENVIRONMENT
G. Wildlife

Section affected:

Pages: II-31 through II-40

Comments:

General observations on the Wildlife section:

Q The number of species documented and approximate size of the study area are accurate, but the literature indicates that considerably more than twenty additional wildlife species "have ranges which overlay the study area". The species list contained in the Appendix of the baseline report lists twenty species of mammals, reptiles and amphibians whose ranges overlap the study area but which were not observed during the baseline study. The literature shows many more species whose ranges are thought to overlap the Spring Creek study area. They were not included in the baseline report because habitat preferences make their occurrence on the site unlikely. In addition to these three classes of vertebrates, the literature shows an additional 40-50 avian species whose ranges overlap the Spring Creek study area. Lack of appropriate habitats on the study area will probably preclude use of the Spring Creek site by many of these species. A review of field guides, rather than the appendices of the Spring Creek baseline report, would reveal considerably more than twenty additional potential species.

Q Your comments have been noted.

R The study area is an important winter habitat for pronghorn, but not because "groups of 100 or more animals have been seen". It is important because these concentrations utilize the study area throughout the winter, remaining on the area the entire season. During other seasons, substantially fewer pronghorn utilize the study area. Pronghorn use was heaviest in the sagebrush/grass and upland grass habitats but the sagebrush habitat is the most important habitat during the winter. Because it occurs in lesser amounts, the number of observations in that type would be expected to be less than in more prevalent types. During the winter, especially a severe winter, the pronghorn rely on the generally larger, more robust plants in the sagebrush habitat to provide a forage source above the accumulated snow.

R The draft statement does not suggest that the sole criterion for delineating pronghorn wintering habitat was the sighting of 100 or more animals. However, large concentrations of animals do indicate that important habitat components, especially sagebrush, are available for wintering pronghorns in the Spring Creek area.

LETTER 23

Figure 10 in the wildlife baseline report shows the greatest use of the sagebrush habitat occurred during the winter seasons and decreased substantially during the rest of the year.

S Although Biggins' 1976 report shows movement of mule deer within and through the Spring Creek study area, he does not discuss "seasonal fluctuations in animal populations" for the Spring Creek Area. During his study, telemetry fixes were obtained once or twice a week for each animal fitted with a radio transmitter collar. This frequency is not sufficient to delineate specific movement routes. The movement of an animal between observations was assumed to have occurred by the most direct route between consecutive observation points. The extensive observations of our biologists on the Spring Creek study area found most movement by mule deer occurred along ridges rather than cutting perpendicularly across drainages. The predominant movement routes coincide closely with the major use areas shown in Figure 11-13 of the EIS with the arrows showing movements between use areas. The majority of deer movement thus skirted rather than transversed the proposed mine area.

T The lowest population estimates in spring, with subsequent increases through the winter, do not indicate "the proposed mine and surrounding area comprise habitat critical to the local and migratory mule deer herd". It does show that the study area supports a much greater population during the winter than during other seasons. Mule deer remain on the study area throughout the winter, indicating that all necessary habitat components exist within this area. For an area to be "critical" for any species it must provide a component, or combination of environmental components, not readily available elsewhere in the vicinity and necessary for the survival of that species. Portions of the Spring Creek study area which could be considered important during the winter months are indicated in the monitoring report as having supported concentrations of mule deer during the severe part of the 1977-78 winter. In general, most mule deer utilized areas adjacent to the proposed mine site rather than the site proper.

S It is considered that the results of Biggins' telemetry studies represent the best available data on movements of individual animals, surpassing the accuracy of documenting movements of unmarked animals.

T The support of much greater concentrations of mule deer during the winter than during other seasons, both within and adjacent to the Spring Creek permit area, suggests that a combination of environmental components exists which is not readily available elsewhere in the vicinity. The displacement of these wintering animals by disruption of the environmental components in the vicinity of the mine may have a detrimental effect on the surrounding populations.

LETTER 23

During the baseline study winter sage grouse concentrations were most frequently found near the "Upper Divide Lek". This area probably does provide "winter habitat for birds from both the "Upper Divide" and "Windmill" breeding-display areas". However, sage grouse winter use patterns in the area do not warrant a finding that the area is "the most important winter habitat for sage grouse within several miles of the area." During the past several winters, sage grouse have regularly been observed in sage covered areas on the western half of the study area. Ease of access to the area near the "Upper Divide Lek" makes observations of birds in this particular place convenient. But on many occasions, sage grouse were not observed within this "winter area" for periods of ten days to two weeks. This intermittent pattern of use tends to diminish the relative "importance" of any single use area.

Bald eagles were predominantly sighted around the Tongue River Reservoir, but they were also observed roosting in trees around the proposed mine site, especially during the early morning hours. Upland roosts such as provided by the mature ponderosa pine trees typically serve as night roosts for eagles.

Section affected:

II. DESCRIPTION OF THE ENVIRONMENT

- G. Wildlife
 - 1. Large mammals
 - b. Mule deer

Page:

II-34 (Footnote 2)

Quotation from DES:

Use of the word "critical" is meant to convey biological importance and is not to be confused with the legal implication contained in Sec. 50-1042 of the Montana Strip and Underground Mine Reclamation Act.

Comment:

Your comment has been noted.

Care is taken to distinguish between the biological importance and legal significance of the term "critical." Unnecessary confusion might be avoided by replacing the term "critical" with a term having less legal significance, i.e., the text might be modified as follows:
 "This indicates that the proposed mine and surrounding area comprises habitat [critical] of biological importance to the local and migratory mule deer herd . . ." (Bracketed material is deleted; underlined material is added.)

U If the inventory of the winter range was a daily, intense ground search, then the 10-day to 2-week absence of birds may be significant enough to change the description to, "...[the most] an important winter habitat for sage grouse...". See text revision, chapter II, Wildlife, Upland Game Birds.

LETTER 23

Sections affected:

II. DESCRIPTION OF THE ENVIRONMENT

- H. Sociology
- I. Economics
- J. Community Services
- K. Land Use
- L. Transportation systems
- M. Recreation
- N. Cultural resources
- O. Esthetics

Pages:

II-40 through II-96

Comments:

V As a general observation, with the exception of transportation systems, the socio-economic sections of the Draft Environmental Statement may be described as subjective and lacking in adequate documentation. To become more useful planning tools, these sections should receive more thorough, more objective treatment.

V The authors believe this analysis is adequate and utilizes the best information available. The comment by NERCO does not question any specific statements or conclusions made in this assessment.

The documentation provided allows any interested party access to the information used in this analysis and from which the conclusions were drawn.

One measure of objectivity is whether other researchers, using the same, or even different, research methodologies will draw similar conclusions. The material provided by a University of Wyoming study group, presented in the final EIS, projects social impacts which are essentially the same as those projected in the draft.

Section affected: III. PROBABLE IMPACT OF THE PROPOSED ACTION
A. Geology LETTER 23

Page: III-1

Quotation from DES: The most important geological impact from implementation of the mine plan would be increased erosion and deposition in the permit area. . . .

Comment: Ongoing studies being conducted in behalf of Spring Creek Coal Company will assess the impacts of mining operations on area stability and the probability of increased erosion and deposition.
Your comment has been noted.

Section affected: III. PROBABLE IMPACT OF THE PROPOSED ACTION
A. Geology
1. Topography and geomorphology

Page: III-1

Quotation from DES: **W** During mining, erosion would be accelerated by an unknown amount as a result of both the surface disruption by men and mining machinery and by the construction of the proposed diversion channels. Also, an unknown amount of hillslope sediment movement would occur as the slopes reestablish an equilibrium with the steeper diversion-channel gradient.

Comment: These statements should be consistent with the sediment load predictions as outlined on pages II-1 and II-10. Descriptions of the Environment, would indicate that the sediment loads are less severe than these statements would imply.

W The erosion rates on page II-1 of the draft EIS refer to present conditions and are expected to be considerably less severe than erosion rates during mining. The probability of increased postmining erosion and deposition would not be significantly different at Spring Creek than at any other minesite. Increased runoff--and, hence, erosion and deposition--is a generally observed problem.

Section affected: III. PROBABLE IMPACT OF THE PROPOSED ACTION

- A. Geology
1. Topography and geomorphology

Page: III-1

Quotation from DES: . . . To the extent that depressions may form, surface water and sediment would collect in these depressions and would, therefore, not reach the major stream channels.

Comment: **X** Indications are that major subsidence will occur within the first five years of reclamation. Consequently, NERCO will have adequate time in which to monitor and recontour, if necessary, the spoil to fill-in any shallow depressions that might develop. Ground surface slopes are designed in the final reclaimed surface for adequate drainage to major stream channels.

Section affected: III. PROBABLE IMPACT OF THE PROPOSED ACTION

- A. Geology
1. Topography and geomorphology

Page: III-2

Quotation from DES: Severe rill and gully erosion would occur on highways reggraded to the proposed 3-to-1 slopes (about 20 degrees). . . .

Comment: **Y** It would be useful to know which sources have been consulted in arriving at this conclusion.

Section affected: III. PROBABLE IMPACT OF THE PROPOSED ACTIONS

- A. Geology
1. Topography and geomorphology

Page: III-2

Quotation from DES: . . . Studies of activities similar to mining, indicate that sediment yield to the mine area would increase about fivefold over present rates (Gregory and Walling, 1973). . . .

Comment: **Z** The publication by Gregory and Walling, 1973, is a general geomorphic text and might not be applicable as a reference for studies of activities "similar to mining."

X It can not be clearly demonstrated that the major subsidence would occur in the first 5 years following reclamation. Appendix D of the Amended Mining Permit Application, submitted August 10, 1978, includes a subsidence report prepared for the company. The report is based upon three study sites: the Decker mine (Montana) where the study area was reclaimed only 5 years ago; the Alcoa mine in east central Texas (average precipitation 34 inches per year), and limited studies in England. The studies in England and in Texas both indicate that most subsidence occurs in the first 5 years following reclamation. However, because the rate of subsidence is, in part, determined by precipitation, the rate of subsidence in the semiarid Spring Creek location would be less than that in Texas or in England. How long subsidence would continue at Spring Creek can best be answered by continued studies at Decker or with monitoring after Spring Creek is reclaimed. However, subsidence can be expected to continue longer than 5 years. If in fact major subsidence occurs more than 10 years after reclamation is started, it could be difficult to establish legal responsibility for correcting the problem.

If significant portions of the reclamation surface (more than a few percent) have to be remanipulated, there could be very real problems with soil compaction and plant disturbance during these operations. In addition, the effective formation of new reclamation surfaces could restart the 10-year bonding period for the affected areas (Neil Harrington, Department of State Lands, oral communication).

Although ground surface slopes would be designed to adequately drain to major streams, it is doubtful that the surface could be graded so perfectly that small depressions, which would collect surface flow, would not be formed.

Y The success of erosion control can only be determined following reclamation; however, numerous references indicate that hillslope erosion increases with increasing slope length (Zingg, 1940; Musgrave, 1947; Wischmeier and Smith, 1960). Reclaimed slopes of this length would be susceptible to erosion.

Z Gregory and Walling (1973, p. 354-358) discuss the activities of man (building construction, highway construction, and strip mining) upon the sediment load in streams.

LETTER 23

Section affected: III. PROBABLE IMPACT OF THE PROPOSED ACTION
B. Hydrology

Page: III-3

Quotation from DES: The loss of surface water (one perennial spring on the South Fork and several ephemeral impoundments on the permit area) would limit future use by livestock and wildlife. The company's proposed mitigating measures are not adequate in that the five water impoundments would fill with sediments in about 10 years, making them useless without further maintenance. . . .

Comment: **AA** Because it is considered important to maintain the same sediment loads as the pre-mining condition, if the post-mining constructed ponds will fill with sediment in 10 years it is expected that the existing ponds would have done the same.

Section affected: III. PROBABLE IMPACTS OF THE PROPOSED ACTION
B. Hydrology

Page: III-3

Quotation from DES: . . . Proposed stream diversions may be subject to erosion. The company does not propose to construct sediment retention facilities on these diversions and therefore, to the extent sediment may be eroded, some sediment may leave the permit area.

Comment: This conclusion serves to point out a potential problem to which the operator must and will give constant attention under applicable regulations.

Section affected: III. PROBABLE IMPACT OF THE PROPOSED ACTION
B. Hydrology

Page: III-3

Quotation from DES: . . . The quality of ground-water in the Anderson-Dietz aquifer east of the permit area may be degraded because of the leaching of spoils and may become, thereby, unacceptable for usage.

Comment: **BB** This conclusion is not fully explained and documented, and the area which might be affected is not well defined.

AA Most existing impoundments within the mine area are situated on tributary drainages rather than main streams. Of those located on South Fork, most are breached. Furthermore, it is not known when these impoundments were constructed.

The five planned impoundments would be located on the main drainages, excavated below the drainage gradients, and would act as sediment sinks. Coupled with an expected increase in postmining erosion on the minesite, these impoundments would probably fill relatively quickly, as discussed.

BB There are insufficient data to support a more definitive interpretation.

LETTER 23

Section affected:

- III. PROBABLE IMPACT OF THE PROPOSED ACTION
 B. Hydrology
 1. Surface water

Pages:

III-3 and III-4

Quotation from DES:

... The proposed impoundments in the permanently relocated channels would function as traps for sediment derived upstream from the permit area during flow events and would fill with sediment rather quickly, thereby losing their effectiveness. The rate of infilling would vary greatly with the intensity of runoff events.

Comment:

CC It should be noted that there are stock watering ponds in existence at the mine site which have not filled with sediment.

CC See response to comment AA above.

Section affected:

- III. PROBABLE IMPACT OF THE PROPOSED ACTION
 B. Hydrology
 1. Surface water

Page:

III-4

Quotation from DES:

... The temporary diversion channels are not designed for flood flows of a 40-year frequency, and may become sources of sediment that discharge from the permit area. The probability of a 50-year event or larger occurring at least once during the life of the mine is 40 percent.

Comment:

DD The scouring alluded to in this paragraph relates to the velocity of the flows, although the calculations for the anticipated flow velocities for the 50-year event are not provided, nor is the velocity of the flows that would be required to remove the clinker lining provided in the statement.

DD See text revision, chapter III, Hydrology, Surface Water. The anticipated velocity of a 50-year flood would be in excess of 7 ft/s, which would erode anything smaller than boulder-size material (less than about 10 inches in diameter).

LETTER 23

Section affected: III. PROBABLE IMPACT OF THE PROPOSED ACTION
 B. Hydrology
 1. Surface water

Page: III-4

Quotation from DES:

... The diversions would be constructed on hillsides to allow mining of the stream bottoms; thus an increase in the sediment yield would be expected.

Comment: Your comment has been noted.

Under the modified mining and reclamation plan, this potential problem has been substantially alleviated by reduction of the need for temporary diversions. This would apply in general to all discussion of impacts associated with Temporary diversion channels.

Section affected: III. PROBABLE IMPACT OF THE PROPOSED ACTION
 B. Hydrology
 1. Surface water

Page: III-4

Quotation from DES:

... Velocities would be especially high in the lower reaches of the diversion channels where the gradients steepen.

Comment: Your comment has been noted.

The diversion channel under the modified mine plan, will be constructed with gradients similar to natural, existing channels which are steeper upslope than down-gradient.

Section affected: III. PROBABLE IMPACT OF THE PROPOSED ACTION
 B. Hydrology
 1. Surface water

Page: III-4

Quotation from DES:

... Because no sediment retention facilities are planned on the diversion channels, sediment eroded from these channels would leave the permit area. . . .

Comment: Your comment has been noted.

Permanent settling ponds have been designed for the permit area to prevent contributions of suspended solids to offsite water courses. The reduced requirement for diversion facilities, under the modified mine plan, will further alleviate the potential for offsite sedimentation impacts.

LETTER 23

Section affected:

III. PROBABLE IMPACT OF THE PROPOSED ACTION

- B. Hydrology
 - 2. Ground water

Page:

III-5

Quotation from DES:

No significant impacts to the alluvial aquifer west of the permit area are foreseen, although the one perennial pond on South Fork immediately west of the area might drain because of disruption related to mining activities.

Comment:

EE It would be useful to know what kind of disruption would cause the pond to drain and how it would do so.

EE The severing of the hydrologic continuity of near-surface aquifers, including the alluvium, by activities related to coal extraction (blasting and overburden and coal removal) may cause a rapid lowering of ground-water levels, which in turn might cause the pond to drain.

Section affected:

III. PROBABLE IMPACT OF THE PROPOSED ACTION

- B. Hydrology
 - 2. Ground water

Page:

III-5

Quotation from DES:

... The water level in a well in the NE $\frac{1}{4}$ NE $\frac{1}{4}$ of section 31 would probably drop to near the bottom of the well, and the unused well in the west-central part of section 24 would probably become dry. The well in the NW $\frac{1}{4}$ NW $\frac{1}{4}$ corner of section 24 is deeper than the well identified above and should not be seriously affected.

Comment:

FF The foregoing conclusion is not supported by adequate documentation. It is important to know how the estimated drop in water level was computed and what calculations were employed to determine that the well would become dry.

FF The well in the west-central portion of section 24 is immediately adjacent to the proposed mine pit boundary and is completed in the same coal aquifer proposed to be mined. It would, therefore, most likely be drained. The well in the NE1/4NE1/4 sec. 31, being only slightly deeper than the bottom of the mine pit and down the hydrologic gradient from the mine, would probably be directly affected, as described.

LETTER 23

Section affected: III. PROBABLE IMPACT OF THE PROPOSED ACTION
 B. Hydrology
 2. Ground water

Page: III-5

Quotation from DES:

The quality of ground water likely would be degraded in the Anderson-Dietz aquifer east of the permit area because magnesium sulfate leached from the spoils would migrate into the undisturbed, downdip coal and clinker horizons adjacent to the mined aquifer.

Comment:

GG The extent of the aquifer and the extent of the area to the east of the permit area which might be so affected has not been clearly identified.

GG There are insufficient data to clearly identify the extent of impact.

Section affected: III. PROBABLE IMPACT OF THE PROPOSED ACTION
 B. Hydrology
 2. Ground water

Page: III-6

Quotation from DES:

At present no wells in the area east of the mine would be likely to survive the lowering of the water tables resulting from Spring Creek and Decker North Extension Mines; therefore, decreased water quality would not be significant to local water use.

Comment:

HH The area east of the mine which might be so affected has not been clearly identified.

HH See text revision, chapter III, Hydrology, Ground Water.

LETTER 23

Section affected:

- III. PROBABLE IMPACT OF THE PROPOSED ACTION
 D. Air quality
 2. Biological air quality impacts

Pages:

III-8 through III-10

Comments:

General observations or Biological Air Quality
Impacts:

II Although not specifically mentioned in the text, those "Biological Air Quality Impacts" discussed for cattle would also be expected in the wild ruminants utilizing areas adjacent to the mining disturbance. Their mobility would allow wild-like movement to less detrimental areas if suitable habitat were available. The increased dust load settling near the mine would tend to increase the heat load of winter snow covers resulting in decreased accumulations and earlier spring melt-off. These conditions would tend to concentrate animals in winter and early spring because of the food availability and reduced hindrance to movements. The artificially induced concentrations in areas of particularly high particulate fallout would accentuate the potential for impacts such as outlined in this section for cattle.

II The increased cattle use around areas of greater dustfall because of changes in microclimate is probable but undocumented. We agree that impacts to cattle due to decreased air quality may also be expected in wild ruminants.

Section affected: III. PROBABLE IMPACT OF THE PROPOSED ACTION
E. Soils
1. Reclamation

LETTER 23

Page: III-10

Quotation from DES:

... [T]he Company proposes to salvage 'topsoil' material to an Electrical Conductivity (EC) value of 8.5 mmhos/cm (State guidelines suggest limiting EC values to 46 mmhos/cm). Such high soluble salt contents have been demonstrated to cause dramatically reduced germination and yield rates (over 50 percent) if forage species even under otherwise ideal conditions (Richard, 1954).

Comment:

JJ Recognizing that the reference to 46 mmhos/cm was probably intended to be 4.6 mmhos/cm, Spring Creek Coal Company would make the following observations: Species with moderate salt tolerance (e.g. cicer milkvetch) can be successfully grown up to EC = 12 mmhos/cm. Western wheatgrass, according to Richards' Handbook 60 is highly tolerant and can be grown as a forage crop up to EC = 18 mmhos/cm. Berstein (1958) indicates western wheatgrass has good salt tolerance from 6 to 12 mmhos/cm. Spring Creek topsoil values are based on 6 mmhos/cm, and at that level 21 inches of topsoil material will be available.

Section affected:

III. PROBABLE IMPACT OF THE PROPOSED ACTION
E. Soils
1. Reclamation

Page:

III-10

Quotation from DES:

... Sodic overburden has been demonstrated to contaminate 12 inches of non-sodic "topsoil" material by upward migration of sodium over a period of 3-5 years (Agricultural Research Service and North Dakota Agricultural Experiment Station Staff, 1977).

Comment:

KK It should be noted that the sodic overburden producing the foregoing result was in all probability more sodic than the overburden at Spring Creek and that at Spring Creek 21 inches of topsoil will be replaced. Established grasses can grow in the type of overburden present at Spring Creek. The seed germination and seedling establishment phases will warrant the most careful observation.

JJ The deliberate placement of solids with a maximum electrical conductivity (EC) of 8.5 would inhibit a wide range of species which are necessary for the establishment of viable, self-sustaining, diverse, and productive plant communities. Re-establishment of a few salt-tolerant species would not meet this requirement. Germination and stand establishment would, in any case, be a problem at an EC of 8.5. The EC values cited by Richards (1954) are levels at which productivity is reduced 50 percent, a reduction which may not be permitted by regulatory agencies.

KK The overburden in the eastern half of Spring Creek, the area most likely to develop sodic soil problems, averages SAR values in excess of 29. The study cited from North Dakota used overburden with a SAR of 27. A "topsoil" thickness difference would serve to alter the rate of sodium translocation but not the process. This point has been demonstrated in the North Dakota experiment in which sodium was shown to move through 5 to 6 feet of nonsodic "topsoil" to increase near surface SAR values from 1 to 4 in 3 years. (Fred Sandoval, Mandan ARS, personal communication, 1978). This increased SAR does not represent a detrimental condition by itself, but the implication of a comparatively rapid and substantial movement of sodium through a large volume of soil is significant and places the difference between 12 and 21 inches of "topsoil" in its proper perspective. Grasses would not be required to grow in overburden materials, since "topsoil" would be replaced. Materials of a similar texture (clay loam to silty clay loam) and SAR levels (25-30 average) could support established grasses but at very low levels of productivity. Undisturbed soils at Spring Creek are of similar texture but have SAR levels averaging less than 5. The soils literature has long dealt with the detrimental effects of sodium on plant growth. These effects are summarized by Omond and others (1975). The development of a sodium problem would occur in a subtle form at a later time, probably between 5 and 10 years after "topsoil" is placed over sodic overburden. Decreased productivity and plant cover with increased erosion would "warrant the most careful observation***."

LETTER 23

III. PROBABLE IMPACT OF THE PROPOSED ACTION

- E. Soils
 2. Site specific problems

III-11

Page:

Quotation from DES:

The State of Montana has not issued guideline values for ESP, but the literature does provide a limit of 12 percent as a division between sodic and non-sodic soils (Richards, 1954).

Comment:

LL Richards (1954) places the sodic/non-sodic soils division at ESP = 15%, not 12% as stated. The magnesium sulfate leaching from the spoils might degrade the down dip water quality is in conflict with a study by Hem, J.D. 1970, U.S.G.S. Water Supply Paper 1473 in which Hem suggests that for magnesium sulfate to dissolve in deleterious amounts there must be more than 1,000 parts per million of sulfate in the dissolving medium. Downward percolating precipitation in the permit area is unlikely to contain this level of sulfate.

LL See text revision, chapter III, Soils; Site Specific Problems.

Section affected: III. PROBABLE IMPACT OF THE PROPOSED ACTION
E. Soils
3. General mining impacts

Page: III-12

Quotation from DES: Typically, these conditions result in dramatic decreases (to 75 percent) in vegetative productivity about 5 years after the start of reclamation procedures.

Comment: **MM** This conclusion is not supported by adequate documentation.

MM While the bulk of the information comes from Colstrip where conditions are not the same as those at Spring Creek, the processes of disturbance, nutrient release, and litter accumulation would be very similar. Reclamation at Decker is too young to provide documentation. (Deput, E. J., and others, 1978; Dennis Hemmer, DSL, oral communication, 1978).

Section affected: III. PROBABLE IMPACT OF THE PROPOSED ACTION
E. Soils
3. General mining impacts

Page: III-12

Quotation from DES: These impacts constitute a basic level sacrifice of range and agricultural resources for the foreseeable future.

Comment: **NN** This conclusion is not supported by adequate documentation.

NN These effects, such as reduced infiltration, loss of soil structure, particle dispersion and topographic uniformity are impacts common to all drastic disturbance in this semiarid region, with few exceptions based on unusual site specific conditions. They are unavoidable during mining, and therefore represent a basic cost, or sacrifice, for coal extraction by surface mining. (ARS, 1977; Schafer, and others, 1978; Omodt and others, 1975; Arnold and Dollhopf, 1977; Natural Academy of Sciences, 1974).

LETTER 23

Section affected: III. PROBABLE IMPACT OF THE PROPOSED ACTION
E. Soils
3. General mining impacts

Page: III-13

Quotation from DES: Specifically, this entails a 2-to-5 fold or greater increase in erosion rates (Lusby and Toy, 1976), decreased plant community diversity, productivity and composition based on soil characteristics and diversity.

Comment: **OO** This reference to the one research project performed by the U.S.G.S. in central Wyoming may not be applicable to the Spring Creek area in southern Montana. It should be noted that Lusby and Toy conclude: "the conclusions discussed in this section are based on data obtained as a part of rainfall simulation studies at rehabilitated and natural sites at two different mines. The rehabilitated sites are not necessarily reflective of the entire rehabilitated area at either mine." (Emphasis added.)

Section affected: III. PROBABLE IMPACT OF THE PROPOSED ACTION
E. Soils
4. Post-mining management

Page: III-13

Quotation from DES: It is possible, even likely, that the Spring Creek area, among others, would be subject to some form of mismanagement through grazing, agricultural, recreation or development during this extended period of instability.

Comment: **PP** There is no support for this conclusion, and, because Spring Creek Coal Company owns the surface mismanagement would not be allowed.

OO This study was also conducted on the Big Horn mine, about 13 miles from the Spring Creek area. The study was well planned and executed, and represents the only formal erosion study conducted on reclamation surfaces derived from Fort Union Formation spoil materials. Precipitation regimes are also comparable. The disclaimer is normal scientific caution in the absence of statistical certainty. See also response to comment XX below.

PP See text revision, chapter III, Soils, Post-mining Management. Historically, all of these negative land use impacts have occurred throughout the region with and without the landowners' knowledge. Since the soils and topography would remain unstable for decades or even centuries, it is clear that there would be ample opportunity for management problems and mistakes. The company has no legal requirements to maintain ownership or management of the surface after the reclamation bond is released. Consequently, long term management is not assured.

LETTER 23

Section affected: III. PROBABLE IMPACT OF THE PROPOSED ACTION
F. Vegetation

Pages: III-13 through III-15

Comments: General observations on the Vegetation section: Your comment has been noted.

Many of the impacts described in the section or vegetation are resolved by the use of revised seeding mixture described in Amendment One to the Mining Permit Application. In addition, Spring Creek Coal Company continues to believe that shrub plantings will be successful as they have been at more arid New Mexico and Wyoming sites. To this end, the Company has dedicated itself to an ongoing program of research and experimentation.

Section affected: III. PROBABLE IMPACT OF THE PROPOSED ACTION
F. Vegetation

Page: III-14

Quotation from DES: Other species such as the deciduous shrubs of the riparian community would be lost for the long term (perhaps several decades), until natural encroachment of these species occurs. Your comment has been noted.

Comment: Spring Creek Coal Company, in its revised seeding mixture, has committed itself to reclamation of the deciduous shrubs of the riparian community.

LETTER 23

Section affected:

III. PROBABLE IMPACT OF THE PROPOSED ACTION
G. Wildlife

Pages:

III-15 through III-18

Comments:

General observations on the Wildlife section:

During the past several years, the Montana Department of State Lands, Reclamation Division, Wildlife Survey Guidelines have undergone considerable revisions. These revisions have resulted in progressively more stringent requirements for both baseline and monitoring studies. The wildlife portion of the Environmental Analysis for the Decker Mine, submitted in 1973, consisted of a three day visit to the site by one biologist. The wildlife study on the Spring Creek mine generally had two biologists on the study area 365 consecutive days. Therefore, the statement, "Impacts on wildlife arising from the proposed Spring Creek Mine would be more severe than any of the other existing or currently proposed coal stripping operations in southeastern Montana," is without adequate support. A one-year, low intensity study of wildlife values within the Birney-Dicker subregion (Knapp 1975 a & b) did not find that the Spring Creek site, contained within the "Decker Lease Area," provided any wildlife values significantly greater than any other portion of the study area. In fact, the "Decker Lease Area" was not classified as a particular distribution or seasonal movement" of mule deer, and concluded "It is obvious that antelope use these (lease) areas mainly in summer and fall." Subsequent intensive studies have documented that winter populations of mule deer and pronghorn are significantly greater than any other season for the Decker Lease Area (Amstrup 1976 & 1978, Biggins 1976, VTN 1977 & 1978, Mike Jackson personal communication).

While it is true that destruction of habitat may have severe impacts, the vast majority of vegetative communities within the proposed surface disturbance area comprise the habitats most prevalent throughout this subregion: sagebrush/grasslands and upland

QQ The determination that "impacts on wildlife arising from the proposed Spring Creek mine would be more severe than any of the other existing or currently proposed coal stripping operations in southeastern Montana" was made by review of available literature and more importantly by field evaluation of all proposed and existing mines in the Northern Powder River Basin. See also responses to comments R and T above.

LETTER 23

grasslands. Table II-10 of the Draft Environmental Statement shows that these two habitats account for 94 percent of the permit area wildlife habitat. A mining operation will temporarily remove the surface vegetation. In the particular case of the Spring Creek Mine, the modified mining and reclamation plan, provides for minimizing highwall reduction on the South Fork of Spring Creek, and will result in the disturbance of less of the Ponderosa Pine/Juniper and Upland Shrub habitats than would have resulted under the original plan. Although occupying small percentages of the permit, and surrounding area, these habitats are important to wildlife within this subregion. For species which rely upon the sagebrush/grassland and upland grassland habitats to provide any necessity, amply alternative areas supporting these habitats surround the proposed mine site. All of the more mobile species on the Spring Creek study area utilize large home range areas which regularly produce use patterns including both portions of the proposed disturbance area and surrounding areas. It appears that none of these species will be totally displaced from their established home ranges by the development of the Spring Creek Mine when mitigative measures are undertaken.

RR

RR The destruction of habitat on the Spring Creek minesite will result in a lowered carrying capacity of the area for existing wildlife species. The occurrence of similar habitats adjacent to the minesite doesn't alter this adverse impact on wildlife. See also response to comments R and T above.

The statement is made that "adverse impacts would be of major significance on a site specific basis" but that in "considering the larger Decker subregion as a whole" the impacts would be significantly less disrupting. The total disturbance area should be less than ten square miles, with the actual mine approximately four square miles. During the sixteen month baseline studies and the subsequent fourteen months of monitoring studies, very few critical wildlife values within the permit boundary were identified (surface water source, food source, raptor nest sites, sage grouse lek and wintering area, mule deer and pronghorn wintering concentrations). Of these values, the only one for which off-site mitigative measures will not produce immediate substitutes for on-site losses are wintering areas. By reducing the disturbance area as proposed in the modified mining and reclamation plan, essentially all critical mule deer winter

LETTER 23

will remain undisturbed. Pronghorn and sage grouse utilize mature sagebrush extensively during the winter. During the three winters of the study, each of these species utilized several areas on and off of the mine site. Additional strands of mature sagebrush plants could not be established within a short time span, and the ability of that portion of the presently utilized winter range lying outside of the disturbance area to support these populations is not known. Areas supporting similar habitats in the proximity of previously identified wintering concentrations may provide alternate winter range sites for both pronghorn and sage grouse.

A great deal of the potential impact to the pronghorn can be mitigated. As stated above, in the baseline report, and in the interim/monitoring report, pronghorn utilized numerous portions of the study area as winter range. If movement routes are not blocked between sites outside of the disturbance area which have supported winter pronghorn concentrations, these sites will likely be utilized during future winters. Regular movement routes to the east and north of the proposed mine site should allow pronghorn access to all portions of their winter range. Where fenced roads or rail lines cut these routes, appropriate fencing will insure no impediment of pronghorn movements.

SS The importance and value of any single pronghorn wintering area is of question. An ongoing, three-year study of pronghorn on lands just south of the Spring Creek study area has documented yearly shifts in winter ranges for all pronghorn herds on their study area (Amstrup 1978). Mr. Amstrup (personal communications) is of the opinion that pronghorn (at least the populations in this subregion) are nomadic and do not form seasonal concentrations on specific, traditional sites. Rather they wander throughout the region and utilize areas they encounter which provide their habitat requirements at that particular time. Their overall range is constructed considerably during the winter season, but still traditional "winter range areas" are not consistently utilized even

Your comment has been noted.

SS Value of and attachment to severe winter habitat in the Decker area is not known since delineations or those sites are quite recent. Development in or near such habitats should be cautious until more information pertaining to them is obtained. See also response to comment T.

LETTER 23

during that season (Amstrup 1976 and 1978).

Mule deer which utilize the Spring Creek lease area year-round probably amount to no more than seven to ten individuals. Because of the lack of cover, and suitable food sources, no mule deer resided exclusively within the lease area year-round. It appeared that few, if any individuals spent more than twenty-four consecutive hours within the lease area at any time during the past two and one-half years. As mentioned earlier, the modified mining and reclamation plan, by retaining some "highwall" areas will substantially decrease disturbance of important deer winter range and movement routes identified around the proposed mine area. Fencing as described for pronghorn will also insure free movement of your deer, incapable of jumping fences which cut across movement routes.

Mining and associated surface disturbance will virtually eliminate small mammals from the areas currently being mined. As reclamation begins, and a vegetative cover is established, reinvasion by these species should occur rather rapidly. Deer mice, by far the most prevalent rodent on the area now, are considered likely to be the first species to invade disturbed areas (Jameson 1955, Pearson 1959). Voles have also been documented to do well on disturbed sites when the vegetation is dense enough to provide food and cover (Baker and Freschknect 1973). Decker Coal Company studies have shown that deer mice invade revegetated areas quickly and in some cases population levels were greater than in undisturbed areas (Pitcher 1976). During that study, a greater percentage of deer mice were captured in disturbed habitats, which also showed greater fluctuations in numbers than native vegetation.

Cottontail rabbit and bushy-tailed woodrat distributions closely coincide with rocky outcroppings. Several other species of mammals, birds and reptiles also make use of these features. Their presence would definitely be enhanced by providing rock/boulder piles randomly scattered across the reclaimed site.

Your comment has been noted.

The abundance of some species (e.g. deer mice and voles) might initially equal or exceed premining numbers following revegetation. Some predators would benefit in the short term from such reestablishment. As population levels of those small mammals stabilize and as vegetation density increases, their availability as a prey base will be diminished. Loss of ponderosa pine and sagebrush/grass habitats and rock outcroppings would cause a reduction in small mammal species diversity. Without the above habitats and rock crevices on the reclaimed surface, use of the area by cottontail rabbits, an important prey for golden eagles, would be diminished.

LETTER 23

Sage grouse are by far the most prevalent upland game bird on the study area and during some seasons utilized the proposed disturbance area intensively. In light of the additional information collected on sage grouse this past year, the potential adverse impacts should be considerably less than suggested by earlier speculations.

sage grouse have utilized areas other than that near the "Upper Divide Lek". Numerous visits during all winters found no sage grouse within this area. Other wintering areas are in much more inaccessible areas and do not receive the frequency of observation that the "Upper Divide Lek" area obtains. Areas where grouse have been seen in substantial numbers (50-100 birds) include the sage covered benches to the WNW and SW of the winter area on the South Fork of Spring Creek. Eng and Schladweiler (1972) found typical sage grouse winter ranges consisted of "large expanses of dense sagebrush on land having little if any slope," and frequently located on benches between drainages. These are the kinds of areas used alternately with the South Fork of Spring Creek wintering area by sage grouse on the study area.

The South Fork site does form an important part of the sage grouse winter range in this area, particularly the westerly portion of the designated wintering area where taller, denser stands of sagebrush occur. There is no evidence to suggest "that sage grouse migrate to this particular wintering area from areas far removed from the mine site". "Windmill" and "Upper Divide" lek counts each spring are more than adequate to account for the number of sage grouse observed wintering on the South Fork of Spring Creek.

Mitigative measures will make removal of the "Upper Divide Lek" of little consequence. The sage grouse lek history on the main fork of Spring Creek, on the Carbone lands, and the nesting and brood rearing distribution documented during the ongoing telemetry study appear to offer potential for reestablishing of a lek out of the disturbance area. Eng (1976) found adult males relocated themselves when a traditional lek site was destroyed. There is no reason to expect a significant adverse impact from the translocation of the "Upper Divide" lek.

UU Until other wintering areas are formally identified (graphic illustrations and data describing intensities of use) our contended importance of the Spring Creek wintering area will be sustained.

Use of the Spring Creek wintering area has not been substantially refuted by local research findings nor reference citation. See text revision, chapter II, Wildlife, Upland Game Birds, and response to comment U above.

LETTER 23

As discussed earlier, there is no short term way to mitigate the loss of winter habitat for the sage grouse. The dense, robust sagebrush stands utilized during this season would require a considerable time lag to develop. Perhaps some improvement of existing marginal stands of sagebrush, by providing irrigation water and or fertilizers, could produce suitable winter range conditions within a shorter time frame. It is not known if surrounding areas, which already receive winter use by sage grouse, are capable of supporting the present population if the South Fork of Spring Creek wintering area is removed. In any event, the modified mine plan would remove only a portion of the South Fork of Spring Creek sage grouse wintering area.

During the spring of 1978, sharp-tailed grouse dancing was observed on very few of the "alternate dancing grounds" identified during the baseline study. Sharptail were not found on any dancing ground on the permit area this past spring (1978). It appears that these dancing grounds contribute little to the regular sharp-tail reproduction on the Spring Creek study area. During the course of the baseline and monitoring studies, the greatest densities of sharp-tailed grouse were found on the western portion of the study area, west of the permit area. That portion of the study area provides a greater amount of typical sharptail habitat: "good quality grasslands and brushy cover are essential for grouse" (Hillman and Jackson 1973). Brown (1971) found sharptail populations varied significantly "between the drier sagebrush and the more moist upland prairies." From "the best stands of intermixed tree-shrub-grasslands breeding sharptails extended their range into marginal areas during years of high populations".

Several raptor nest sites would be displaced by the proposed Spring Creek mine. Some of these sites are inactive nests and have not been utilized during the past two years. The only active raptor nests on the permit area include one great-horned owl, one turkey vulture and several kestrel nests. If human activity is restricted in the vicinity of raptor nest sites during the winter months, most nests peripheral to the mining disturbance could remain active.

LETTER 23

Several instances of golden eagle, kestrel and great-horned owl nests in close proximity to active mining endeavors have occurred in this region. Probably the greatest adverse impact to raptors will be the loss of hunting territory once small mammals are removed by the mining.

An intensive effort to reestablish vegetation as soon as possible on mined and recontoured areas will minimize this impact. The potential new nest sites and hunting perches which can be created by retaining some cliff areas along the South Fork of Spring Creek would help offset similar sites removed in mining the "central bluffs" area.

LETTER 23

III. PROBABLE IMPACT OF THE PROPOSED ACTION

- H. Sociology
- I. Economics
- J. Community services
- K. Land use
- L. Transportation systems
- M. Recreation
- N. Cultural resources
- O. Esthetics

Pages: III-19 through III-40

Comments:

WV As a general observation, with the exception of the section on transportation systems, the socio-economic sections of the Draft Environmental Statement may be described as subjective and lacking in adequate documentation. To become more useful planning tools, these sections should receive more thorough, more objective treatment.

WV The authors believe this analysis of the impacts of the proposed Spring Creek mine is adequate and utilizes the best information available. The comment by MERCO does not question any specific statements or conclusions made in this assessment.

The documentation provided allows any interested party access to the information used in this analysis and from which the conclusions were drawn.

One measure of objectivity is whether other researchers, using the same, or even different, research methodologies will draw similar conclusions. The material provided by a University of Wyoming study group, presented in the final EIS, projects social impacts which are essentially the same as those projected in the draft.

LETTER 23

III PROBABLE IMPACT OF THE PROPOSED ACTION

- K Land use
 - 2 Regional impacts
 - 3 Cumulative land use impacts

Pages III-34 through III-36

Comments

General observations on regional and cumulative land use impacts:

The authors will want to consider the expansion of this section by providing more detail which, if available, would be in the site specific DEIS and EIS statement and the regional impact statement now under preparation. More specifically, readers would probably find it helpful if some or all of the following materials were incorporated in the EIS:

1. A map setting forth the location of the Decker, Big Horn, Ash Creek, North Extension of Decker, Shell Pearl, Consol. CX Mines. (This might be done by expanding Figure I-2.)
2. Projection of the tonnages of such mines and, if known, their projected markets.
3. If available, employment projections on these mines.
4. The acreages involved in each of the aforesaid operations.
5. Either a sketch or a brief description of the proposed transportation systems.

Considerations of these regional factors were made in preparation of the draft environmental statement; however, it is felt that specific discussion of other mines and cumulative regional aspects are beyond the scope of this site specific ES. These factors will be discussed in the Northern Powder River Basin regional ES, to be published in 1979.

LETTER 23

V. ADVERSE IMPACTS THAT CANNOT BE AVOIDED IF
THE PROPOSALS ARE IMPLEMENTED

V-1

Mining would decrease the stability of about 4,420 acres of reclaimed land surface, thus resulting in increased erosion and deposition in the permit area, locally as much as 5 times the present levels."

Under the modified mining and reclamation plan, the disturbed area has been reduced 3632 acres. The conclusion that erosion and deposition may be as much as 5 times present levels is not supported by adequate documentation.

V. ADVERSE IMPACTS THAT CANNOT BE AVOIDED IF
THE PROPOSALS ARE IMPLEMENTED

V-1

The several-hundred-yard-long perennial reach of South Fork in the southeast corner of the permit area would be eliminated . . .

Studies by Spring Creek Coal Company do not show the wetted zone to be this long.

V. ADVERSE IMPACTS THAT CANNOT BE AVOIDED IF
THE PROPOSALS ARE IMPLEMENTED

V-1

The water level in one currently used well (NE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 31, R. 8 S., R. 40E) would be lowered, possibly enough to make the well unusable.

There appears to have been no documented use of this well in recent times, although the well is apparently in operating condition. Therefore, it might be unfair to conclude that the well will become unusable.

XX The modified mine plan was not submitted until after the Spring Creek DES was published. See chapter VIII discussion on the Central Field Mine Plan.

Gregory and Walling (1973, p. 354-358), citing examples of man's activities in the Eastern United States, show that these activities have produced increased sediment loads ranging from a 10-fold increase to a 40,000-fold increase. Even given climatic differences, a 5-fold increase seems a conservative estimate.

YY See text revision, chapter V.

ZZ See response to comment FF.

Section affected: V. ADVERSE IMPACTS THAT CANNOT BE AVOIDED IF ^{LETTER 23}
THE PROPOSALS ARE IMPLEMENTED.

Page: V-2

Quotation from DES: The carrying capacity of the permit area would be reduced for all wildlife and greatly reduced for certain species.

Comment: **AAA** It is unreasonable to assume that the removal of four square miles of habitat from this subregion will have such impacts. This is especially true when mitigative measures are conscientiously undertaken and the disturbance is limited to removal of those areas shown in the amended mine plan. By prohibiting livestock grazing on the permit area, the additional forage available to wildlife could even increase the carrying capacity of the area, especially for big game species. It is doubtful that any major wildlife species will be impacted to such a degree as to significantly effect subregional populations. **AAA** See discussion of impacts to wildlife, chapter III, Wildlife.

LETTER 23

Section affected:

VI. THE RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF MAN'S ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

Page:

VI-1

Quotation from DES:

... Land use would change from grazing and wildlife habitat, as soils were progressively disturbed and vegetation removed, ultimately on nearly all of the 4,420-acre permit area.

Comment:

Most wildlife attainment of pre-mining diversities and densities will lag behind the vegetative development. With the proposed change in topography and difficulty in reestablishing similarly diverse native habitats, it is likely that the disturbance area will support a wildlife population which varies from the pre-mining population. Those species which rely on the most mature seral stages of vegetation phenology will probably show decreased use of the area until such communities develop. (NOTE: Under the modified mining and reclamation plan, the area affected is reduced to 3,632 acres.)

Your comment has been noted.

LETTER 23

Section affected:	VIII. IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES
Page	VIII-1
Comment:	Primarily as a result of the modified mining and reclamation plan, many of the impacts described as irreversible and irretrievable commitments of resources will be reduced or eliminated.
	Your comments have been noted.

LETTER 23

Section affected:

- VIII. ALTERNATIVES TO THE PROPOSED ACTION
 E. Alternate mining plan - Central
 Field Mine Plan
 2. Proposals of the Spring Creek
 Coal Company
 c. Reclamation

Page:

VIII-23

Quotation from DES:

The Company has not provided any additional
 mitigatory measures.

Comment:

The modified mining and reclamation plan addresses
 this point in great detail.

Your comment has been noted.

Section affected:

- VIII. ALTERNATIVES TO THE PROPOSED ACTION
 E. Alternate mining plan - Central
 Field Mine Plan
 4. Environmental impacts of the
 proposal
 a. Geology
 (1) Topography and geomor-
 phology

Page:

VIII-26

Quotation from DES:

Water released from the settling pond to the
 natural drainage would be sediment deficient
 compared to natural stormflow.

Comment:

BBB It is unknown how much water would be released
 from the settling pond or how much sediment
 would be carried by the water.

BBB State and Federal regulations (Title 69, Chap. 48, R.C.M., 1947;
 30 CFR 715.17) allow for these waters to carry a suspended sediment
 load no greater than 70 mg/L or approximately 70 ppm. Wilson (1972)
 has reported that sediment concentrations of runoff from summer
 thunderstorms in the Western United States are in excess of 10,000
 ppm. Therefore, it appears that if the company complies with
 regulations it would release sediment deficient waters, regardless
 of the total amount of sediment and water released.

LETTER 23

Section affected:

- VIII. ALTERNATIVE TO THE PROPOSED ACTION
 E. Alternative mining plan - Central Field Mine Plan
 4. Environmental impacts
 a. Geology
 (1) Topography and geomorphology

Page:

VIII-27

Quotation from DES:

... The stability of both of these [stability of transformation from tributary to reclaimed channel and stability of reclaimed channel] is at present unknown."

Comment:

CCC Plans for the reclaimed channel and clinker lining have been discussed in the modified mining and reclamation plan.

CCC The modified mining and reclamation plan was submitted after the DES was published. See chapter VIII discussion on the Central Field Mine Plan.

Section affected:

- VIII. ALTERNATIVES TO THE PROPOSED ACTION
 E. Alternative mining plan - Central Field Mine Plan
 4. Environmental impacts of the proposal
 2. Geology
 (1) Topography and geomorphology

Page:

VIII-27

Quotation from DES:

In the long term, perhaps thousands of years, the reclaimed surface is geomorphically unstable.

Comment:

DDD This applies equally well to the natural surface, since this region is in a state of active geomorphic change, both for natural reasons and, as importantly, because of over grazing and other agriculturally related activity. Therefore, the conclusion that the reclaimed surface is geomorphically unstable for perhaps thousands of years is not particularly meaningful.

DDD The region, although subject to high natural rates of erosion which are further increased by grazing and other agricultural activities, appears to be in balance with present climatic conditions. It is not undergoing rapid geomorphic change. If the reclamation surface is constructed as proposed, drained by a single, long reclamation channel having no tributaries, a more elaborate drainage network would develop over long periods of time. During the redevelopment of a drainage network, erosion rates would remain abnormally high.

Northwestern Mining Department
F. D. Owsley
Manager

August 18, 1978

Mr. Glen Malmberg
USGS
PO Box 1135
Billings, Montana 59103

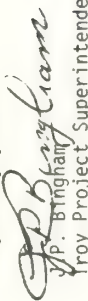
Dear Glen:

Thank you for sending me a copy of the draft environmental statement on the Spring Creek mine.

I have reviewed the statement and feel the document adequately accesses the impact of the proposed mining operation. I was particularly impressed with the obvious environmental awareness NERCO has shown by programming environmental safeguards in their mining program. I also have confidence the reclamation plan presented will be successful. I suggest this document is adequate to also represent the final environmental statement.

Development of the project will obviously be in the best interest of the state and people of Montana and I favor the mining permit being issued in due course without hamstringing optional restrictions.

Very truly yours,


J.P. Bingham
Troy Project Superintendent

JPB:ams

cc: CPhillips

Your comments have been noted.

LETTER 25

BURLINGTON NORTHERN

Director, U. S. Geological Survey October 6, 1978
National Center
Mail Stop 108
Reston, Virginia 22092

Dear Director:

Your letter accompanying the Draft Environmental Statement, Spring Creek Mine, Big Horn County, Montana, invited comment to be considered in preparing the final statement. We are pleased to have the opportunity to do so.

The statement, on pages VIII-9, VIII-45 and VIII-46, discusses the possibility of using coal slurry pipelines as a "possible alternative to rail transport" from the mine. VIII-46) indicate "economic operation of slurry lines" (page VIII-46) requires large diameter lines handling a large volume of product. This should be emphasized, since operation at maximum capacity is essential and such operation is hardly feasible under actual operating conditions. Fluctuations in power plant demand, technical and other problems associated with loading the line at origin detract heavily from optimum economics and must be considered.

It should be noted here that only one coal slurry pipeline, the Black Mesa Line, now is operating in the United States. It is not competitive economics which made this line possible, but the fact that terrain made it impractical to serve the mine with a railroad. Also, it should be noted that the owners and operators of this line never have revealed the charges made to the customer for transporting the coal and in fact have refused to do so when questioned.

It is assumed in paragraph four that pipeline transport "would mitigate some of the adverse impacts of rail movements." There is no substantiation for the assumption of adverse impacts or of the statement that slurry lines would mitigate impacts. The only adverse impact of slurry lines mentioned is the possibility of local coal contamination due to operational failure. If adverse impacts are to be discussed, there should be exploration of the impacts of both transportation methods, not just rail.

A A partial but by no means exhaustive list of adverse impacts imposed by slurry pipelines would be: dissipation of scarce water urgently needed for purposes other than pipelines and for which no substitute exists, soil compaction and subsidence in construction of the line, pollution in slurry dump ponds, disposal of contaminated water at terminals, changes in water courses along the pipeline route, invasion of farm and ranch lands.

B There is an assumption that favorable Congressional action on federal eminent domain privileges for slurry pipelines would make those lines a "...viable and competitive alternative to rail transportation of coal to market." (Section 4, paragraph 1, page VIII-9). No supporting data is offered for this conclusion. As noted above, actual cost figures for pipelines are not disclosed and the economics depends heavily upon pipeline diameters and use of capacity. Likewise, it is stated in the following paragraph on that page that "...several slurry pipelines have been used successfully to transport crushed coal, iron ore, and other minerals over appreciable distances." A 275-mile haul is used as an example. This is the only slurry line in operation in the United States, despite the fact slurry lines have been technically feasible since the 19th century. The only other coal slurry pipeline constructed in the United States was in Ohio and was closed down on the advent of coal unit trains.

C In that same paragraph there is a reference to "dust, noise and traffic danger," purportedly arising from railroad operations which would be eliminated, it is asserted, by use of slurry pipelines. Again, there is no supporting data for this conclusion, even though data on dust pollution had been made available to your staff. I would like to call your attention to page 9, Railroad Transportation Safety District Air Particulate study by Nalco Environmental Sciences, Lincoln, Nebraska which states in regard to Burlington Northern coal unit trains: "Optical analysis of particulate samples revealed that emissions from diesel locomotives and coal loads were insignificant with all samples showing only trace amounts (1 % by number) or less."

D This same paragraph indicates the water requirements of coal slurry pipelines but fails to compare this consumptive use with that required by coal unit trains. There is no supporting data for the conclusion in that paragraph that slurry water could be "readily developed from local or imported source." In Montana, where the Spring Creek Mine would be located, exportation of water for slurry purposes is expressly prohibited by law.

A Obvious mitigations attributable to pipeline over rail operation involves noise and crossing conflicts with highway or street traffic. This is not to ignore disruption during pipeline construction or noise potentials around pumping plants but to recognize that differences in location, timing, and perhaps kinds of impacts which exist between these modes of transportation. Impacts of rail transport are examined in detail because this is the proposed method of transporting coal from the minesite. It is not our purpose to recommend pipeline movement of coal but to recognize that it does exist as a potential alternative.

B This statement includes the qualification that legislation "may" make pipelines a viable and competitive alternative. It is not unreasonable to assume such legislation would contribute to such an outcome, although it would not of itself create viability or effective competition.

C In the Air Particulate Study by Nalco Environmental Sciences, only 10 out of 70 trains (14 percent) were loaded with coal during a 2-day sample period. Such a sample size is not a basis for concluding that coal dust off unit-trains is insignificant.

The Nalco study showed that the "railroad" may contribute a range of 24 to 55 $\mu\text{g}/\text{m}^3$ to dust concentrations of the immediate vicinity. This is an increase of 30 to 70 percent over the reported baseline for TSP. As the study pointed out, such increases were largely due to the re-entrainment of dust around the railway corridor by train movement. In the long term, there may be considerable re-entrainment of coal dust lost off unit-trains.

Coal dust off unit-trains has been reported as a significant public nuisance (Guarnaschelli, 1977). The nuisance as well as the potential for significant coal dust loss is seasonal, since erodibility of coal is greatest during the summer months (Guarnaschelli, 1977). Residential property values adjacent to railroads may be decreased (Poon, 1978). The biological toxicity of western coal dust to living organisms has not been investigated. Preliminary studies from other areas and different coals suggest that inhibition of fruiting and induced leaf necrosis on broad-leaved fruit trees may occur (Kao, 1971). Excessive coal dust deposition may cause necrosis of spruce needles or death of the trees (Auclair, 1976). Extracts from western Canadian coal proved to be nontoxic to fish even at high concentrations (Guarnaschelli, 1977).

In view of the potential for esthetic as well as environmental impacts from unit coal trains, we feel that coal dust loss of unit-trains should not be ignored.

See text revision, chapter III, Air Quality, Primary Impacts.

D It is believed that sufficient water is available or could be developed if legal and/or political priorities were changed.

LETTER 25

Director, U. S. Geological Survey
October 6, 1978
Page 3

It is noted that water availability would involve lengthy resolution by various bodies. This, of course, is both true and significant. For your information as to public attitudes on such use I am attaching a list of groups and individuals objecting strongly to slurry pipelines, with water the principal source of objection.

Table III-1 on page III-9 gives estimated uncontrolled atmospheric emissions at the mine including estimates of particulates, SO₂, NO_x, HC, HCN, Aldehydes and Organic Acids, all without source. It is thus impossible to determine the accuracy of these estimated emissions.

On page VIII-45 section 9, it is noted that relative energy efficiencies of rail and slurry lines are subject to conflicting evidence. I would like here to refer you to page 145, A Technology Assessment of Coal Slurry Pipelines, Office of Technology Assessment, Congress of the United States which reads in part: "Although pipelines require less steel, recycling is less costly for railroads. Similarly, the energy directly required to process the steel and for coal transportation is greater for pipelines than for rail, averaging for the cases 610 BTU/net-ton-mile for pipelines and 390 BTU/net-ton-mile for railroads." It also should be taken into account that all steel for pipelines must be produced new, while railroads require, in most cases, only replacement steel for lines already constructed and in use.

I would like to comment only briefly on the conclusions in regard to impacts on wildlife in the area. On page III-7 it states "Major north-south and east-west migration routes between major use areas and local movement would be blocked by mining activities and the railroad corridor." It concludes these use areas would be isolated from other use areas. There is no indication whether this conclusion resulted from research by competent wildlife jurisdictions, either state or federal, and if so, which.

Your map, Figure II-14 on page II-37 shows present and projected locations of railroads and highways. Existing State Highway 314 separates all these areas, with the exception of a small area between Tongue River Reservoir and Highway 314 north of the Decker loop track. If added impact is confined to this area, the nature and importance should be noted and verified.

On page III-7 the general conclusion that sharp-tailed grouse populations would be reduced secondarily by elimination of "dance areas", one of which is near the railroad loop, should likewise be verified by research data.

Appendix D-3, "Theoretical Maximum Particulate Emissions," shows how all particulate emissions were calculated.

Pollutant emissions due to population increase are referenced in EPA 450/1-73-001. Diesel emissions from coal trains are referenced in: URS, Coal Train Assessment. Final Report, December 15, 1976, p. V-16. Gaseous blasting emission factors are based upon ideal combustion of ammonium nitrate-fuel oil mixtures and are referenced in: Chaiken and others, 1974, Toxic fumes from explosives--ammonium nitrate-fuel oil mixtures. Report of Investigations 7867. USDI, Bureau of Mines, 24 p. Vehicular gaseous emissions are based on diesel powered scrapers and heavy duty gasoline-powered trucks with emission factors referenced in EPA/AP-42, Part B, February 1976.

Your comment has been noted.

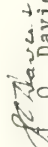
The principle authors are biologists assigned to the task force from the U.S. Fish and Wildlife Service and Bureau of Land Management. All conclusions reached have been reviewed for accuracy by the Montana Department of Fish and Game, while most of the basic data were gathered by professional biologists employed by NERCo.

Director, U. S. Geological Survey
October 6, 1978
Page 4

LETTER 25

We appreciate the opportunity to examine the DES and to comment on it, and I hope these comments will be useful in preparing the final form.

Sincerely,


J. O. Davies

cc: Mr. Glenn Malmberg
Federal Task Force Leader
U. S. Geological Survey
P. O. Box 1135
Billings, Montana 59103

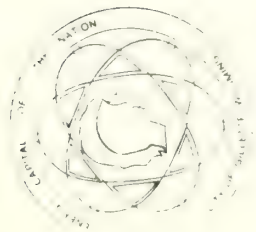
Mr. Craig Howard
Spring Creek Coordinator
Department of State Lands
1625 11th Avenue
Helena, Montana 59601

LETTER 25

ORGANIZATIONS OPPOSED TO
COAL SLURRY PIPELINE LEGISLATION

American Farm Bureau Federation
Farmers Union
National Wheat Growers Association
American National Cattlemen's Association
Association of American Railroads
Railway Labor Executives Association (includes 20 Unions
representing ALL railroad employees)
Express and Station Employees
Brotherhood of Railway and Airline Clerks - Freight Handlers,
United Auto Workers - Leonard Woodcock Testimony, 1975,
Senate Interior Committee (S. 740)
United Mine Workers - Arnold Miller Testimony, 1976, House
Science and Technology Committee, Fossil Fuels
Subcommittee, ERDA Authorization
Environmental Policy Center
Sierra Club
Friends of the Earth
Western Governors Regional Energy Policy Office, Inc. (includes
Arizona, Colorado, Montana, Nebraska, New Mexico, Nevada,
North Dakota, South Dakota, Utah, Wyoming)
Governors of the Old West Regional Commission
Midwestern Conference of the Council of State Governments
Northern Plains Resource Council
Northern Plains Region of Conservation Districts
Kansas Grain and Feed Dealers Association
Kansas Wheat Growers
Montana Stockgrowers Association
Montana Cattlemens Association
Montana Chamber of Commerce
Economic Development Association of Eastern Montana
Montana Democrat Party
Montana Republican Party
Montana Farmers Union
Montana Woolgrowers Association
Montana Association of Conservation Districts
Western Environmental Trade Association (Montana)
Nebraska Grain and Feed Dealers Association
Nebraska Association of Resource Districts
Nebraska Stockgrowers Association
Nebraska Farm Bureau
North Dakota Water Users Association
North Dakota Water Management Districts Association
Chamber of Commerce of: Columbia Falls, Sidney, Forsyth, Missoula,
Glendive, and Wolf Point, Montana
Powell and Greybull, Wyoming
Williston, North Dakota
Laurel (Montana) City Council
General Assembly, Commonwealth of Virginia (Resolution)

(copy)



City of Gillette

October 11, 1978

Director
U.S. Geological Survey
National Center
Mail Stop 108
Reston, Virginia 22092

Re: Draft Environmental Impact Statement, DES 78-30, Spring
Creek Mine, Federal Coal Lease M069782

Dear Sir,

I am writing in reference to the draft environmental impact statement for the proposed Spring Creek Coal Mine. Although we are not located in the immediate vicinity of this mine, the City of Gillette will apparently be experiencing an increase in the number of coal trains passing through the city as a result of the mine. The increase in train traffic has already caused significant problems.

At this time we have only one grade separation on the extreme west end of the city. The hospital, the fire station, the police station and many other public services are located on the south side of the railroad tracks. Access to the north side is primarily via grade crossings. Gillette is presently investigating alternative proposals for an additional grade separation in the eastern part of the city. However, the initial cost estimates on such a grade separation show it to be well beyond our means.

A We believe that the environmental impact statement should address this mine as a significant contributing factor to a larger over-all environmental impact being created by such industrial activities. The cumulative effect of train traffic resulting from this mine and other mines in the area are creating problems for the City of Gillette in the areas of safety, noise and dust. We believe the statement should examine these effects in more detail and propose specific mitigating measures which should be implemented by the energy company, the railroad, or federal agencies who may have the resources to implement such solutions.

A See text revision, chapter III, Transportation Systems, Cumulative
Transportation Impacts.

LETTER 26

Page 2
DES 78-30

Director, U.S.G.S
October 11, 1978

Thank you for the opportunity to comment on this statement. I would be very happy to discuss these matters in more detail with you or your staff at any time.

Sincerely,



Michael B. Enzi
Mayor

MBE/jar/lgw



Northern Cheyenne Research Project

P. O. Box 388
Lame Deer, Montana 59043
Phone (406) 477-6278

Oct. 11, 1978


The Director
U.S. Geological Survey
National Center
Mail Stop 108
Reston, Virginia 22092

Dear Sir,

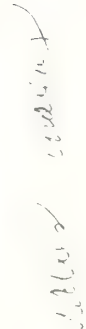
We would like to reemphasize a point made at the hearings on the proposed Spring Creek Mine in Big Horn County, Montana: the overwhelming importance of evaluating Spring Creek Mine in a regional context. An evaluation of potential environmental impacts of the Spring Creek Mine is meaningless until the regional environmental statement is prepared and analyzed. The cumulative effects of various mines in the area may result in serious environmental degradation, a fact which is ignored when considering only one mine at a time. It would seem appropriate that no action be taken on permitting this proposed mine until the regional environmental context of this mine is analyzed.

Your comment has been noted.

Sincerely,


Dr. Elin Ouligley
Environmental Scientist

Dr. Charles Andrews
Hydrologist, Geologist





Northern Cheyenne Research Project

P. O. Box 388
Lame Deer, Montana 59043
Phone (406) 477-6274

Boggs

10/10/78

H. William Menard, Director
U.S. Geological Survey
National Center
Mail Stop 108
Reston, Virginia 22092.

Dear Mr. Menard:

Enclosed please find a copy of my written comments on the Draft Environmental Statement for the proposed Spring Creek Mine, Big Horn County, Montana. These are my own comments, and do not necessarily reflect the views of the Northern Cheyenne Tribe. Thank you for your consideration.

Sincerely,

James P. Boggs, Ph.D.
Research Sociologist,
EIS Coordinator.

LETTER 28

LETTER 28

COMMENTS ON THE PROPOSED SPRING CREEK MINE DRAFT EIS

James P. Boggs, Ph.D.

10/10/78

These written comments supplement verbal testimony presented at the Spring Creek Draft EIS hearing held at Decker, Montana on September 20, 1978. At that time I made some suggestions for strengthening the sociological sections dealing with local ranching communities. Here I would add that the sociology sections of the Spring Creek Draft, as they consider the non-Indian population of the area, are better than those in most EIS documents, because they do raise many of the significant issues. They identify local communities who will be affected and they consider quality of life impacts at this level.

In contrast, there is a notable lack of any discussion of Northern Cheyenne or Crow sociology and culture in this document, either in the baseline "Description of the Environment" section, or in the "Probable Impact of the Proposed Action" section.

For example, Table II-13 on p. II-45 reveals that in 1970 the Indian population comprised 39 percent of the population of Big Horn County. Yet the section of Social Organization dealing with Big Horn County on p. II-46 begins "Big Horn County is socially organized into natural rural communities . . .", referring only to the non-Indian rural communities. Northern Cheyenne and Crow sociology and culture are completely

A The text has been changed to make it clear that the area of primary social impact would be within the southeastern panhandle of Big Horn County, specifically within the natural rural community of Decker and the urban area of Sheridan (figure II-17). Primary social impacts would probably not be felt on the reservation, which lies north and west of Birney. Some secondary effects would occur, primarily due to increased traffic, economic activity, and increased population pressures. Traffic increases would be noticeable on Highway 314 from Busby to Decker. We were not able to fully analyze the effect of these secondary impacts on the reservation, but they are not expected to be major.

Boggs, Spring Creek, p. 2

LETTER 28

ignored, although Cheyennes and Crows make up about 40 percent of the county's population, and the Cheyenne Tribe is located near the proposed mining area. If an immediate impact area were defined, as should have been done, what proportion of that area would be Cheyenne?

Similarly, distinctive features of the Crow and Northern Cheyenne economies are not addressed. There is no economic analysis, although the topic is introduced. On p. II-64 it is noted that government is a major employer and that there is a high unemployment rate for the

B Northern Cheyenne Reservation, but nothing more. Under economic impacts, four generalized categories of impacts to the Reservations are listed on p. III-28, but no substantive discussion is presented or referenced to indicate the magnitude of the impacts, the probability of their occurrence or non-occurrence, mitigating measures, alternatives to the proposed action in relation to these impacts, nor any of the other features of an EIS analysis that are required by law or by state-of-the-art standards.

As a social scientist it is impossible to address meaningful comments to an analysis that does not exist. The Northern Cheyenne Research Project, a program of the Northern Cheyenne Tribe, for which I work, applied to the U.S. Department of the Interior for funding to provide an analysis of impacts to the Northern Cheyenne Tribe from this mine and from the other proposed projects being considered in conjunction with the ongoing Northern Powder River Basin EIS. The Tribe was not provided funding to prepare such an analysis, although large amounts

B Page III-28 of the draft EIS lists some possible impacts on the Northern Cheyenne Tribe. These impacts fall into two categories: cultural conflict between Whites and Indians, and the relative deprivation of lower income people as they perceive themselves falling further behind workers with higher incomes. Our analysis indicates that the Spring Creek mine would not significantly increase total population near the reservation, and thus would not dramatically increase cultural conflicts. The disparity between average incomes of Whites and Indians would continue even without the proposed mine and, thus, cannot be attributed to the mine itself. See text revision, chapter III, Economics, Indian and Indian Reservations.

Boggs, Spring Creek, p. 3

LETTER 28

of money were and are being spent on these projects. I mention this now because it is germane, in light of the failure of this draft EIS to address Indian issues, that there was a possible alternative.

Since the required analysis is virtually absent from this draft, it is hard to see how supplying such an analysis for the final EIS would meet legal requirements. An analysis present in the Final but absent in the Draft EIS will not have been made available for public review and comment. The only way that I or anyone else could comment on the problems of social and cultural impacts to the Northern Cheyenne in relation to this Draft EIS, since the draft contains no baseline or impacts analyses, would be to provide those analyses. However, it should not be left up to the public to provide its own EIS analyses--that is the job of the responsible agencies. Therefore, the lack of such analyses in this draft EIS represents a serious failure of the responsible agencies to fulfill their legal mandate for full disclosure and public review. I hope that the forthcoming drafts for the other site-specifics in this area and for the Northern Powder River Basin Regional EIS contain sufficient analyses of Northern Cheyenne and Crow social, cultural, and economic issues for meaningful review.

The appearance of this Draft EIS at this time raises some more general and fundamental issues at the regional and national levels. The situation is greatly confused in the region as a result of the overlapping jurisdictions of federal and state agencies, and the tie-ins between site-specifics in this region, of which this Draft is one,

Boggs, Spring Creek, p. 4

LETTER 28

and the forthcoming Regional EIS. This Spring Creek Draft EIS explains some of this situation on p. I-1. I understand that this site-specific analysis was broken out of the regional analyses in order to meet the State's legally-defined 240 day limit between submission of a completed mining application and the State's final action on that

C application. Apparently, then, the State is not required to consider the regional implications of cumulative impacts from a number of similar development projects, as is the Federal government under NEPA. But it would seem then that there would be a problem with the State's taking final action on this site-specific before the Federal agencies make their decision, because since the two decisions will be based on the same data and analyses, there is some danger that the one might tend to set a precedent for the other. The Department of the Interior will, of course, have to consider this application in light of the cumulative regional impacts as well, but it is unclear, at least in my mind, how these will relate to Interior's decision on any one specific application. In any event, I would appreciate a somewhat clearer explanation of these problems, which it may be appropriate to include in an expanded "Description of the Proposed Actions" section in Chapter I. The situation is inherently confusing, I realize, but it could perhaps be unravelled a little further.

Finally, on the national level, I am concerned that the larger issues relating to policy be fairly addressed. Presumably the new programmatic EIS coming out pursuant to the NEDC (sic) vs. Hughes case will address policy issues. The Spring Creek application apparently was

C The State of Montana is required to assess cumulative impacts in accordance with ARM 26-2.2(18)-P280 (Rule IV) and ARM 26-2.2(18)-P290 (Rule V). These rules provide no definitive criteria for determining to what extent such impacts must or should be addressed. Further, MEPA and the rules adopted pursuant to MEPA are directed toward individual actions and not a series of similar actions; therefore, the cumulative impacts would be the impacts of the decision at hand added to those impacts already realized by previous decisions on similar developments. This was the approach utilized in assessing those impacts attributable to the Spring Creek mine.

Boggs, Spring Creek, p. 5

LETTER 28

not affected by the NRDC vs. Hughes case, but that case is mentioned on p. I-1. It would be very helpful to me, strictly in my capacity as a concerned citizen, and I would think to decisionmakers as well, if the relationship between this Draft EIS and NRDC vs. Hughes were very briefly reviewed in Chapter I. Since the new programmatic will deal with a new government policy, but one that apparently does not affect the Spring Creek applications, this application must be reviewed in light of some preexisting policy or policies. It may well be necessary under the law for action on Spring Creek that this policy be advanced and subjected to public review through the EIS process; or this may already have been done. I do not know. But it would be helpful if this situation also could be briefly explained, and the policy under which the decisions affecting the Spring Creek application will be made could be identified or concisely articulated.

The two preceding paragraphs do not deal with substantive issues in the Draft EIS itself, but they do ask for clarification of the regional and national contexts within which the substantive discussions in the Draft presumable take place. There are important considerations on the regional and national levels that relate to this and to other specific decisions. These are not easily discussed in detail in a local site-specific EIS, but it would help make that analysis more understandable if these larger issues could be referenced or introduced in some way. I appreciate agency consideration of these comments, and hope that they are appropriate in this context.

(copy)

DThe case of NRDC vs. Hughes 437 F. Supp. 981 (D.D.C. 1977), amended, 454 F.Supp. 148, appeal pending has no bearing on the pending decision on the Spring Creek proposal. Any decision which may be rendered regarding mining plan approval would be based on the rights already conveyed, and in accordance with the Surface Mining Control and Reclamation Act of 1977; associated Federal and State statutes and regulations; and the Montana Strip and Underground Mine Reclamation Act of 1973.

Tri-County Ranchers Association

Birney, Montana 59012

LETTER 29

October 3, 1978

Director
U.S. Geological Survey
108 National Center
Reston, Virginia 22092

Dear Sir:

We of the Tri-County Ranchers Association are glad to have an opportunity to comment on the planned Spring Creek mine in Big Horn County, Montana. Because we are ranchers in the Birney and Decker areas, this proposed mine (and its accompanying development) raise many serious questions in our minds. Will our air be fouled? Will our community services (schools, police, hospitals, etc..) be overstrained? Will our road to Sheridan be busier and more dangerous? Will we, as local taxpayers, be forced to "pick up the tab" for NERCo's impacts? Will NERCo be kept within the law? Can this land be reclaimed after mining?

Before a permit is issued for this new mine, these questions must be answered.

We trust the Department of State Lands and the other responsible state and federal agencies will take our comments into serious consideration.

Thank you.

Sincerely,



Mary Daniels
President,
Tri-County Ranchers
Association
(an affiliate of the
Northern Plains Resource Council)

LETTER 29

Tri-County Ranchers Association

Butte, Montana 59012

The following are our comments on the Draft EIS for the proposed Spring Creek mine. To make it simpler, we have grouped them under general topics, rather than going page-by-page.

A Air Quality--The EIS points out a potentially very serious air pollution problem if the mine is developed. (page III-6, III-7, and V-I.)

The EIS goes as far as to state that "It is anticipated that maximum allowable Montana guidelines and federal primary standards for 24-hour concentrations of total suspended particulates (TSP) would be exceeded several times a year. Fugitive dust, theoretically amounting to as much as 21,000 tons per year, would adversely affect the growth of vegetation, as well as animals that feed on that vegetation." (page V-I) We must keep in mind that that Decker-Spring Creek area already is the site of two major stripmines, with another mine also on the drawing boards. The pollution from Spring Creek would worsen an already bad situation.

B The EIS also claims that "...workers at Spring Creek exposed to high dust concentrations may suffer some or all of the following diseases: coal miner's pneumoconiosis, silicosis, or industrial bronchitis. . . These diseases are correlated to high carbon content of the coal dust, and to extremely small particle size." To lessen or eliminate these air quality problems, NERCo should be required to design an implementation plan for air quality monitoring as suggested in the "Alternate Mitigation Measures" section. Also, NERCo should be required to store coal in enclosed "silos" as Decker Coal Co. uses at its East mine. This could help to eliminate part of the fugitive dust problems. All tipples and loading machinery should also be covered to avoid dust-blow such as experienced at Western Energy's Colstrip mines.

A See text revision, chapter III, Air Quality.

B See text revision, chapter VIII, Alternate Mitigation Measures, Air Quality.

LETTER 29

C There, the dust blown off the loading piles and the tipples onto a nearby pasture have been blamed for giving cows "black lung" disease. Installation of adequate pollution controls must be required as part of the permit process.

We should point out that blowing dust would harm not only area livestock, vegetation and humans. It could also reduce visibility on the nearby road to Sheridan. The EIS shows predominant winds at the mine site coming from the West-Northwest, which could blow dust across the road.

D Reclamation--Serious doubts are raised in the EIS as to whether successful reclamation is possible at Spring Creek. First, we should note that "...sodium absorption ratio exceed the state suspect levels throughout the mine area. Levels of manganese, nitrate, pH, and soluble salts vary considerably, and some portions of the overburden contain values exceeding state suspect levels." (page II-5) The EIS continues later to categorically state that "successful reclamation would be unlikely under the proposed mining and reclamation plan. . ."

(page III-10) because of soil salinity and sodic overburden. The draft EIS also lists many site specific characteristics of the soil and overburden that would hinder reclamation, and criticizes the company's reclamation plan as inadequate to deal with these problems. Even with NERCo's Alternative mining plan, the EIS says the same basic problems exist. The EIS even goes as far as to state "...the net result of the alternative mine plan's reduction in topsoil material would be a reduction to some degree for the chances of successful reclamation throughout the permit area." (page VIII-30)

E It should be remembered that serious problems with sodic and toxic overburden were encountered at the Decker mines several years ago, which touched off a statewide controversy. Problems included trying to find enough neutral material to cover the toxics and sodics. Spring Creek is not far from

C There is a problem with coal dust on plants and soils in the vicinity of Colstrip, but there has not been any documentation of "black lung" disease in cattle linked to that source. At the March 11, 1978, hearing conducted by the Montana Board of Health and Environmental Sciences, Doug McKee testified that on land adjacent to the Western Energy mine, he noticed considerable coal dust deposition, even in streambeds used by his cattle. He attributed a 4-percent increase in cattle deaths from respiratory ailments, called "shipping fever," to increased coal dust in 1976. Inoculations for shipping fever, which had not been necessary in the past, reduced the loss to 1.5 percent in 1977.

Testimony by Dr. Herb Smith, a veterinarian specializing in bovine respiratory disease, offered evidence at the hearing that coal dust could cause respiratory disease in cattle but that further studies would be needed to clarify the nature of the respiratory ailments in cattle.

D Highway 314 is about 2 miles downwind from the proposed Spring Creek mine. Although dust from the mine may decrease visibility in the general area, it is not likely to impair drivers' vision on the highway. The exception would be during periodic blasting or coal-fire fumigations. Plumes from blasting or coal fires would travel close to the ground and would impair visibility (chapter III, Air Quality).

E The placement of "topsoil" and spoils at Decker has been monitored closely enough to determine the probability of sodium contamination of surface materials. The process does require time to develop to the point where the sodium content is high enough to affect erosion and plant growth. Obviously, however, if "topsoil" is placed over highly sodic overburden spoils, either at Decker or at Spring Creek the processes of sodium movement would be very similar, although site specific characteristics would affect rates of movement.

Spring Creek comments--page three

LETTER 29

Decker, and from the data in the EIS, the same problems would reoccur.

According to state law, a company must submit an acceptable reclamation plan to the Department of State Lands before a permit can be issued. We trust that the DSL will force NERCO to adopt a good plan before any action is taken on the permit. If the department is not satisfied by NERCO's plans, then the law would force DSL to deny the permit request. We, as agricultural people, insist on adequate reclamation of mined lands. If the DSL deems necessary, it should prohibit strip-mining in areas where reclamation is not feasible.

Increased Road Use--The EIS says that the new mine would "...result in increased accident rates, system deterioration, rising maintenance costs..." on the local roads. (page III-36) As local residents, this is very important to us. We frequently use the road to reach Sheridan, our trade and market center.

And increase in adverse impacts on our road (already overloaded by the amount of mining activity in the area) would be very dangerous. The EIS says traffic on highway FAS 314 would increase substantially, especially during shift changes at the mine. To ease this dangerous problem, NERCO should be required (as part of the permit process) to provide a bus system for miners to and from the mine. This would help ease traffic congestion, and hopefully cut the number of accidents and the amount of road maintenance.

Compounding the road problem would be the additional rail crossing along the road, and the increase of rail traffic. To guard against accidents, (and loss of life) NERCO should be required to provide lighted crossing signals and a railroad grade separation (either an underpass or an overpass).

The taxpayers of Big Horn County should not be expected to pick up the tab for NERCO. To be a responsible "industrial citizen," then NERCO should pay for the impacts it creates. The Draft EIS does well to point out the dangers, but it fails to mention the needed safety measures.

F The State and Federal statutes and regulations under which a mining and reclamation permit could be issued do not provide the authority to require bussing as a criterion of compliance.

G As stated on page I-17 of the draft EIS, the relocation of FAS 314 would eliminate the need for any additional grade crossings. It is beyond the scope of this document to discuss mitigatory measures that both have not been proposed, and can not be legally imposed and enforced.

Spring Creek comments--page four

LETTER 29

Socio-economic impacts--The Draft EIS does a fine job of pointing out the socio-economic impacts of imposing a transient industrial economy on a stable, sustained-yield ranch culture. The two just don't mix, and problems inevitably occur.

According to the EIS, existence of the Spring Creek mine will cause:

- 1--Strain on community services (police, hospitals, sewage systems, schools, etc. pages III-28, 31, 32 and 36.)
- 2--Culture conflict (hostility, loss of community, alcoholism, crime, divorce, delinquency, depression, etc. page III-22)
- 3--Infringement on traditional agrarian community (page III-19)
- 4--Suburbanization, subdivisions, etc. (page VII-1)
- 5--Shift in local politics from ranchers to miners (page III-22)

A related subject includes plans for a construction workers' camp

Hand a proposed Spring Creek subdivision (to house mine workers.) If the subdivision or construction camp are built, then the negative impacts would be mostly in Big Horn County, not in the Sheridan area. We must keep in mind that the Draft EIS assumes there will be no "new town" when it predicts negative impacts.

As the EIS points out, most of the above mentioned problems are unavoidable if the mine is put into production. The question then is, **I** who will pick up the tab? The EIS is wrong in giving the impression that coal impact monies from the severance tax could even come close to alleviating socio-economic impacts. Major strip-mining in ranching areas disrupts the community. The only way to avoid the disruption is to deny the mine permit.

However, in the event the mine gets a permit, then money must come from somewhere. Have the county governments involved developed any plans for coping with the impacts from yet another mine? There are no indications

HThe comment is essentially correct. The development of a new urban area in southern Big Horn County would shift some of the total impact to Montana and away from Sheridan County. The magnitude of the shifted impact would depend on the proportion of the new population in the area, from Spring Creek and from other mines, that would settle in the new town. A more extensive analysis based on an assumed new town will be made in the Northern Powder River Basin regional EIS.

The degree of mitigation of social impacts caused by the new town would depend on several unknowns, including whether the town would be self-sustaining or a bedroom community, and its attractiveness as a place to live compared with Sheridan.

IMoney alone cannot mitigate impingements on the quality of life, but money can help to mitigate impacts on community services. Money from the coal severance tax or other sources would be used to alleviate adverse effects within Montana, but there are no means for sharing revenues generated in Montana with Wyoming.

Spring Creek comments--page five

LETTER 29

in the Draft EIS that they have.

We doubt that Sheridan or Big Horn Counties (or Rosebud, for that matter) could provide adequate police protection, road maintenance, medical care or teachers to handle the new influx of miners and construction workers. As the Draft EIS states, "community services in the Birney-Sheridan area are currently being impacted due to population growth and increased demand for services. Expansion of existing services and provision of new services is lagging behind demand." Keep in mind that this "population growth and increased demand for services" is due to coal development. Coal revenue may have lined the pockets of some merchants in the area, but it has not provided adequate community services for the miners, construction workers or the local ranch families.

Perhaps the questions concerning a subdivision at Spring Creek and the planned construction worker camp should be tied to the mine permit process. The two developments are obviously dependent on the mine, and should be analyzed along with the mine proposal itself.

Parenthetically, to the best of our knowledge NERCo has not submitted any plans for its construction camp to the Department of Health and Environmental Sciences subdivision bureau. It is unreasonable for a company to push for a mine permit when they have not made public any plans for housing its construction workers.

Unfortunately, there are few legal ways of paying for development impacts. The EIS pins its hopes on the taxpayers of Big Horn and Sheridan Counties, a vague suggestion of "corporate mitigation" and unspecified "federal assistance." (pages VIII-42 and 43) It seems irresponsible for a firm to plan such a major disruption in an area without being required to pay its own way in terms of the public services for which it will create a huge demand. Perhaps NERCo could somehow be required to provide capital

J The section on community services in chapter II indicates the various government entities which are responsible for providing services.

K See response to letter 30-A, and response L below.

L Spring Creek Coal Company had an environmental assessment (EA) prepared by a private consulting firm, which has filed the EA with the Big Horn County Commission.

M Other than the various taxes for which the company and its employees would be subject, there is no legal avenue to require that the company provide direct funding for public services.

Your comment has been noted.

Spring (reck comments--page six

LETTER 29

for new school facilities and teachers, road maintenance, and medical clinics.

Hydrology--The draft EIS says that "the company's proposed mitigating measures are not adequate in that the five water impoundments would fill with sediments in about 10 years, thus making them useless without further maintenance." (page III-3) The DSL should follow through and make sure

NERCO commits to adequate mitigation before a permit is issued.

Alluvial Valley Floors--NERCO has formulated a mine plan which, it claims, will avoid the alluvial valley floors in the area. The Department of State Lands will make the final determination on the legal existence of any

N alluvial valley floors in the permit area. Also, it must be kept in mind that the federal strip mine law prohibits mining that would materially damage the quality or quantity of water in surface or underground systems feeding the alluvial valley. A determination must be made as to whether the Central Field Mine Plan would pass this test. Statements in the Hydrology section of the Drift EIS raise doubts as to whether it can. The Draft EIS suggests that the alluvial aquifer could be drained and "...an unknown amount of sediment would be added to the Spring Creek drainage." We feel mining would damage water feeding the alluvial valley, and that should therefore be prohibited or restricted.

NERCO's reputation--In late August, T-CRA became aware of rumors that NERCO had been doing unauthorized site preparation work at Spring Creek. A call to DSL confirmed the rumor. A staffer from Northern Plains Resource Council (of which we are affiliate members) learned from DSL that they had drawn up violation notices for NERCO's illegal culvert and well drilling work. However, NERCO claimed it had received "permission" from a DSL employee over the telephone. DSL withdrew its violation notices, refused NERCO

N See appendix S.

Spring Creek comments--page seven

LETTER 29

an additional request to do roading, and withheld judgement on a request to put in a powerline corridor. T-CRA president Mary Daniels wrote to DSL commissioner Leo Berry jr. expressing dismay over the NERCo violation affair, and urging DSL to stand firm and keep the company within the law.

Judging from this incident, NERCo needs to be closely monitored.

The fact that it tried to do major site preparation work before it had even submitted a complete mine permit application is indicative of the company's dedication to "getting the job done" rather than to obeying the law.

Before a mine permit is issued, there is no guarantee that a mine will be legally allowed. Therefore, no site preparation should be allowed before a permit is issued.

Conclusion--The plans for the Spring Creek mine do not predict a good future for the Birney to Sheridan area. This region is already suffering from many large strip mines and we are concerned about the start of yet another major mine.

We trust that responsible state and federal agencies will take action to minimize the impacts from this development. Or, if that seems impossible, to deny it a mine permit.

Thank you.

(copy)

LETTER 30

4877 Birdseye Road
Helena, MT 59601

October 13, 1978

Mr. Leo Berry, Jr., Commissioner
Montana Department of State Lands
Capitol Station
Helena, MT 59601

Dear Sir:

The following comments and observations are in response to the Spring Creek Draft Environmental Statement, the first in a series of coal impact assessments covering long range mining and conversion activities throughout the Northern Powder River Basin in Eastern Montana. These comments are intended to utilize deficiencies in the Spring Creek document as a means of illustrating problems in the E.I.S. process and to offer constructive examples of necessary changes in both the document and the process.

A The Spring Creek mining proposal is closely tied to the building of a new town near Decker, Montana and to the construction of a 2000 megawatt coal fired powerplant complex at nearby Prairie Dog Creek, just south of the state line in Wyoming. The town and powerplant have both been discussed publicly and in the local newspapers. The planning of these two projects has been revealed in only very superficial terms and information has not been made available to the Northern Powder River Task Force. Since the mine-town-powerplant projects are mutually dependent and will result in significant cumulative impacts, it is necessary that they all be considered concurrently and in detail. Since the development interests are not yet willing to discuss all details, the current level of analysis promises to be piecemeal and inefficient. The unnecessary time and expense involved in step by step impact assessment can be avoided by either awaiting completion of plans or by further investigation of the proposals. The fact that the Spring Creek mine has already made coal contracts with other parties simply indicates an ongoing chronic problem common to Montana; initial company investment which then drives the environmental impact assessment process to facilitate the development plan. This problem is further complicated by the usage of the Montana Strip and Underground Mine Siting Act. This act allows the State only limited time to consider the Spring Creek mining application. This legislatively imposed deadline is another forcing element which has resulted in the Spring Creek mine being separated from the comprehensive (originally intended) regional impact study. The State and Federal regulatory agencies must not allow such legal processes to destroy the integrity of the regional study by causing a mining permit to be prematurely issued at Spring Creek.

The Northern Powder River Basin EIS Task Force was designed to allow joint State-Federal participation in regional impact assessment of coal development. These groups, while attempting to work cooperatively have

A The Spring Creek mining proposal is not closely tied to the building of a new town near Decker, Montana. Spring Creek Coal Co. has no ties with Spring Creek Development, Ltd., a limited partnership in Big Horn County proposing the building of the town of Spring Creek. The success of the Spring Creek mining venture, the subject of this EIS, would not be dependent upon the building of a new town as is evidenced by the existence of the Decker mine complex. It is agreed that the viability of a new town would be dependent upon mining industry's ability to attract "new" people to this area but not necessarily dependent upon Spring Creek Coal Co.'s proposal per se.

Pacific Power & Light Co. has proposed a coal-fired powerplant at one of the six locations, Prairie Dog Creek being but one of the proposed locations. The logical source of coal for a powerplant at Prairie Dog Creek would be the Spring Creek mine; however, under the current mining proposal being considered by the Montana Department of State Lands and the Office of Surface Mining (the "Central Field Mine Plan" discussed in chapter VIII), the entire production from the mine is committed to Utility Fuels, Inc., by contract.

It is not considered that the proposals are mutually dependent for the above reasons. Should all the proposals be implemented at one time or even mutually exclusive of one another, substantial cumulative impacts would exceed the purpose of this EIS and would necessarily detract from the intent of this document.

LETTER 30

Leo Berry, Jr.
October 13, 1978
Page 2

operated under different philosophies which has resulted in a reduction of quality in the Spring Creek document.

The State team was originally formed as a group of resource specialists which operated autonomously, exclusive of close political control. Such a group was able to identify many mining related impacts which included issues never previously confronted in EIS documents. Efforts were made to discuss some of these issues in the Spring Creek Environmental Statement since they profoundly influenced the effects of coal development in Montana. Some of these issues are pointed out below and are presented as areas which need to be covered in the Spring Creek document in order that the holistic effects of coal development may be understood.

Coal companies have a lot of money and the State government needs money. The passage of the 30 percent severance tax is an indication of a new economic relationship where the State slowly develops a dependence for funding. If coal money can be utilized to provide tax relief to the population, the political structure of State government becomes more secure because the voters are satisfied. While financing public relations and legislative lobbying efforts, the companies are also in a position to make significant campaign contributions to those who wish to hold public office. Furthermore, the companies employ directly or indirectly many people. These new voters in the sparsely populated Eastern Montana counties will elect prodevelopment legislators. A new town in Big Horn County will profoundly affect the political structure in that area. The intervention of coal mining at Spring Creek may add to these circumstances.

The political structure of the State will respond to large scale coal development. This structure also controls the regulatory agencies which in turn interact with the companies. Currently, the regulatory activities regarding coal mining range from good to bad. Our mining regulatory agency is operating with acceptable efficiency but it is pushed to its very limit. Personnel shortage, low pay and high employee turnover have created a condition of less than optimum capability. The air quality regulatory agency is virtually inactive and ineffective in its responsibilities regarding coal mining. Other areas such as water quality, wildlife, etc., are still difficult to evaluate. The effectiveness of regulatory agencies is a reflection of political priorities; these conditions will govern the type and extent of impacts caused by mining at Spring Creek. The EIS must consider this issue in the assessment of impacts.

Part of the coal severance tax is designated for use in grants to coal impacted areas. The Spring Creek document does not explain how this grant mechanism works, or if it does work. There appears to be a potential for conflict in the definition of impacts between local and State government. Are the worst impacts even considered in the use of these funds, or are these funds used to gratify communities in lieu of impacts

B The EIS does not predicate its assessment of impacts on what a specific law might require or on the ability of a governmental agency to enforce a specific act. Rather, the impacts are based on the proposal made by the company and the effectiveness of mitigation proposals to reduce or alleviate those impacts. Where possible, the assessment of the magnitude and significance of the impacts were referenced to existing laws (note for example Air Quality impacts on pages III-6 through III-10 of the draft EIS). It is not the subject of this EIS to assess the ability or effectiveness of regulatory agencies' enforcement of acts which they administer.

C Grants for providing assistance to areas which have experienced impact, "as a direct consequence of coal development**", are initiated by local government units requesting such assistance. In order to qualify for a grant, these local governmental units (counties, towns, school districts, etc.) must have experienced or expect to experience a 10-percent increase in population during any 3 years since 1972 as a result of coal development. Approval or denial of such assistance is judged on the basis of five (5) guidelines: need, severity of impact, degree of local effort, availability of fund, and planning. The mechanism for approval or denial of grants are governed by the statute, "Impact From Coal Development" Title 50, Chapter 18, R.C.M., 1947, and the rules pursuant to this act M.A.C. 22-3.14(1)-01400 et seq.

LETTER 30

Leo Berry, Jr.
October 13, 1978
Page 3

which can't be remedied or even clearly defined?

D Also, not discussed in the Spring Creek document is that portion of the severance tax which is placed in a trust investment fund. If these funds are invested in the wrong areas, they could be promoting more environmental problems in Montana or throughout the nation. Are these funds being invested in energy development which is leading the nation further down the path in the wrong direction? It would be ironic if these funds were being fed back into the companies which were paying and resisting the severance tax. To understand the environmental significance of coal taxes collected from the proposed Spring Creek mine and other current operations it is necessary to at least list where this money is being used.

Another issue involved in the Spring Creek Environmental Statement is the objectivity of the agencies producing the document. The State team has recently been placed under the control of the State coal regulatory agency. The lead Federal agency (U.S. Geological Survey) is also a coal regulatory agency. Both of these agencies have a legacy of involvement in coal development.

When a regulatory agency produces an impact assessment of its own regulatory activities, this is in effect a form of self analysis. It is naive to expect that the analysis will reveal insurmountable or embarrassing problems with environmental or political. This situation is the causative factor in the avoidance of sensitive issues which will actually govern most of the impacts which were recognized in the document.

The above issues point out contradictions in the E.I.S. process which are reflected in the superficial analyses presented in the Spring Creek document. The document is interesting and informative regarding effects, but does not address causes in sufficient depth. The political structure and its regulatory arm must share in the responsibility for impacts. The political influence of regulatory processes also include the integrity of environmental protection laws. For example, air quality regulations are the result of a political compromise, and rarely reflect the optimum level of environmental protection. However, these laws and others of similar nature are cited as mitigations used for environmental protection. Such conclusions are not logical and pose a contradiction in the field of environmental science. Such contradictions and superficial logic is legally sound and may be excusable when practiced in purely political regulatory circles. The need to perform an objective environmental assessment of coal mining requires that the regulatory agencies involved be far removed from a position of influence in such a project.

Sincerely,
Charles van Hook
Charles van Hook

D It is assumed that the portion of the coal severance tax being referred to is the "permanent coal-tax trust fund." As of September 30, 1978, \$8.25 million were available for investment. Of this amount \$5.95 million had been invested in fixed income securities according to the following table:

Company	Amount	Principle amount of bond (percent)	Year due
Baltimore Gas & Electric----	\$300,000	9.375	2008
Bell Telephone of Canada----	400,000	9	2008
Beneficial Corp.-----	300,000	8.35	1988
Krocker National Corp.-----	500,000	8.60	2002
Diamond Shamrock-----	500,000	8.50	2008
Dow Chemical-----	200,000	8.625	2008
Ford Motor-----	200,000	8.375	1984
General Telephone of California-----	200,000	8.875	2008
Idaho Power-----	500,000	9	2008
Mountain States Telephone----	500,000	8.625	2018
Southwestern Public Service-----	150,000	8.75	2008
Texaco-----	200,000	8.50	2006
Utah Power & Light Co.-----	300,000	9.125	2008
Virginia Electric-----	200,000	9.625	2008
Federal National Mortgage----	500,000	7.50	1987
Federal National Mortgage----	500,000	8.55	1988
U.S. Government Guaranteed Shipping Bonds-----	500,000	8.20	2002
Total-----	\$5,950,000		

An additional \$2.3 million was available for investment which was in the "short term investment pool."

October 11, 1978

Leo Berry, Jr.
Commissioner
Montana Department of State Lands
Helena, Montana 59601

H. William Menard, Director
U.S. Geological Survey
National Center
Mail Stop 108
Reston, Virginia 22092

Dear Mr. Berry & Mr. Menard:

I have spent the past few days again reviewing the draft EIS on the proposed Spring Creek Mine in Big Horn County, Montana and would like to make some written comments which are supplemental to my verbal comments at the public hearing in Decker, Montana on September 20, 1978. The focus here, again, is only on economics. My view that the draft EIS is inadequate in its economic analyses has only been strengthened in recent days. I still think that major revisions will have to be made in this document for it to comply with existing State and federal environmental law (though a court case or cases would be necessary to prove this assertion). I would hope that you will provide an adequate economic analysis in the final EIS so that lawsuits will not be necessary to force your respective agencies to meet your statutory obligations to the people. You are going to be on tenuous ground if you permit this mine without really knowing what the economic impacts will be, as you will not if this Spring Creek EIS is your only source of information.

The economics of this draft EIS gives the appearance of a "quick and dirty" job. What could have been a precedent setting EIS in its economics, as well as the remainder of the document, is instead the more or less standard back bureaucratic product typical of government agencies which, partly through the production of such non-substantive decision-making documents, give every appearance of being development oriented. It appears that the final content of the economics of this document was compiled under the direction of non-economists, or by economists who have forgotten about the standards of their profession. The only thing the economics of the draft has to recommend it is that is not lengthy. Unfortunately, the economics sections might as well have been left out altogether if the purpose was to spell out the economic impacts that are likely if the proposed mine becomes reality. In short, this document tells me almost nothing about the economic impacts of this proposed mine; I would expect the non-economist reader to be even more mystified.

LETTER 31

A In general, the EIS downplays the economic impacts of the proposed Spring Creek Mine. Notice, for example, that there is nothing on economics in the "Summary of Adverse Effects" section in the first chapter of your draft. Further, I find nowhere an account of who would benefit from the coal mine and the extent to which they would benefit. Your document would be improved by a straight forward cost benefit analysis of the proposed mine. I have questions to answer here would be how much is PP & L going to make in profits from this mine? 2How much income from mining employment will be generated? 3How much revenue will be created by BLM revenues from royalties on federal coal, and how much will accrue to the State of Montana from this federal revenue? 4How much in royalties will go to the State of Montana from the mining of State coal, and how will this be spent? 5How much money will the State of Montana as a result of the Montana coal tax? 6How much revenue will go to Big Horn County in connection with the property tax? And so on, in terms of benefits.

B 1On the cost side, what are the costs to the public and to the State coal tax fund going to be in connection with this mine? 2What are the costs to agriculture going to be? 3What costs will be borne by the Native American population in the area? 4What increases, specifically associated with this mine, in public services and expenditures are likely to be expected in Sheridan County, Wyoming? 5Further, will working conditions in the mine produce injuries and deaths on the job? Who will support the casualties of the mine and their dependents in years to come?

C What if your assumption that most of the new miners will live in Sheridan County turns out to be false? It is possible that a new town in Big Horn County will be constructed. Also, there is no analysis of the use of the coal that would be mined. What if PP & L exercises its option to obtain 5 million tons of coal each year? Will this coal be burned in a Sheridan County power plant, and what will be corresponding impacts from that project? (It would seem this should be evaluated in at least a cursory fashion if the Spring Creek Mine location is a decisive factor in the power plant location, as appears to be the case I discovered in conversations with various PP & L executives).

D What about the economics of wildlife loss from the mine? Will, for example, low income and other people who hunt in the area be affected by this mine.

As in most EIS's, the existing economic environment section is probably the most adequate part of the economics of this EIS. However, the main problem is with Native American economy, which is extremely thin here. Of course, the Northern Powder River Basin EIS Task Force could have avoided this problem completely if Secretary Andrus would have provided funding for the participation of the Northern Cheyenne and the Crow in the Northern Powder River regional coal EIS. This funding was requested and was denied. The Northern Cheyenne Research Project could have provided valuable input into these sections. The lack of any analysis of impacts on the Indian population and resources from this mine is a serious oversight in this EIS. Further, the few assertions contained in the document on Indian economy are not as good as could be, even without Crow and Northern Cheyenne participation. What is there is not very intelligible. For example, on page II-63 the section on Crow economics begins with two contradictory

A-1 An estimation of monetary returns to the mining company is not available. Any estimate would necessarily be imprecise, due to unforecasted costs, such as interest on borrowed funds, rate of attrition and replacement of machinery, future taxation, and future productivity and sales. New technologies could have a similar effect on mining employment and, concurrently, the amount of income introduced through payrolls.

A-3 Spring Creek has 283 million tons of Federal strippable coal. The royalty rate is 5 percent, or 37.25 cents per ton at current prices. The royalty would therefore produce \$105,417,500 over the life of the mine, of which \$52,708,750 (50 percent) would be returned to the State. Such funds may be used only for roads and schools within the State but not necessarily within the county of origin (Krutilla and Fisher, 1978).

A-4 The Montana State severance tax would produce \$2.235 per ton at current prices. Over a 25-year period, 243 million tons of Federal coal would be mined, producing \$543,000,000 in severance tax revenues. Appendix I-4 shows active grants by the Montana Coal Board; future disbursements will depend on Coal Board priorities, the nature of applications, future revenue sharing, and the ability of counties to finance services through traditional sources.

See appendix I-2.

A-6 Costs to the public and the State coal tax fund cannot be predicted with any precision. See response A-5 and A-6, above.

B-2 Agriculture has not yet experienced greatly increased external costs from mining, as shown by increases in the amount of cropland in the region concurrent with increased mining and urbanization. The minesite itself is not suitable for dryland crop production and as rangeland is not of high productivity for the region, so the loss of agricultural production would not be significant.

See response to letter 28-A.

See tables III-4 and III-5.

B-5 Accidents to coal miners would undoubtedly occur but would be much less than in an underground mine of comparable size. Workman's Compensation and Social Security payments would pay for most, but not all, of these costs. In addition, union benefits would very likely pay for some of the costs.

See response to letter 29-H, I.

See text discussion, chapter III, Wildlife and Recreation.

See text revision, chapter II, Economics. Crow Economics and Northern Cheyenne Economics, and response to letter 28-B.

LETTER 31

-3-

statements (i.e., government is the biggest Crow employer, and agriculture is the largest Crow employer). Your source of information on the Crow economy is not noted, and therefore your observations, thin as they are, are suspect. You repeat the same contradictory beginning two sentences in your Northern Cheyenne economics section. A more recent and better source than the BIA document you cite on the Northern Cheyenne economy is the 1977 Northern Cheyenne Air Quality Redesignation Report and Request. Further, you could have used information from the 1977 Old West Regional Commission documents for both the Crow and Northern Cheyenne situation.**

On page 11-50 it is noted that there are no "official" data on coal mining employment in the area. While this is true, it would be better to use Montana Coal Council data which the NPRB EIS Economics work group had gathered. Various data has been compiled in EISs on Decker and Westmoreland in Big Horn County and on Western Energy in Rosebud County. In short, the mining situation can be discussed without "official" data, using standard research techniques. In the footnote on page 11-50 you state that Hardin is peripheral to the regional area (which you never define). Of course, this is not true when it comes to matters of county taxation and expenditures in Big Horn county.

On page 11-52 you present unemployment data as if this data were reliable for rural Montana counties. This is not the case, and a note to that effect should be included under your table. On page 11-54 you note that the Sheridan County service industries are "quite large". Is this really true? In absolute or proportionate terms? Compared to what? Compared to New York City? Or Hardin? In the paragraph on the bottom of that same page you assert that "economic analysis" done indicates the net export of agricultural and mining products from Big Horn County. You then say, in a footnote, that this analysis stems from location quotients (LQs). Actually, the LQs you utilized were a commentary on employment and income in agriculture and mining, not exports, but, of course, common sense suggests that if proportionately more people are employed in mining and agriculture and more income is derived in these industries than is the case nationally, then some of these products are exported. What do you mean by "higher concentration" later on in this paragraph and less concentration in the next paragraph? And, actually, it is not clear that "remaining industries" are less prevalent. The data on these industries could simply be overwhelmed by the data of unusually active industries in the area.

On page 11-58 you assert that there "is a tendency to depend more and more upon the coal severance tax for . . . revenues." Is there? Or do increased coal taxes simply reflect more mining. I don't think you can support this statement without proving that tax efforts in other areas (e.g., income tax in Montana) is decreasing and that this is directly related to coal tax revenues.

**See The Northern Cheyenne Research Project, The Northern Cheyenne Tribe and Energy Development in Southeastern Montana, Old West Regional Commission, 1977 and Crow Impact Study Office, A Social, Economic and Cultural Study of the Crow Reservation: Implications for Energy Development, Old West Regional Commission, 1977.

Your comments have been noted.

F "Higher concentration" means that a higher percentage of the total employment occurs in the trade industry than in the U.S. as a whole. "Less concentration" means that a lower percentage of the total employment occurs in the remaining industries than in the U.S. as a whole (table 11-14). The same holds true for income (table 11-18).

G See text revision, chapter II, Economics, Tax Structure, Revenues, and Expenditures.

-4-

On page II-63 you state that coal severance taxes collected from Big Horn County constitute a large income for the State of Montana. It would seem to me that you also should include some kind of analysis of current expenditures and projected expenditures to deal with the damage of mining and mitigation on the county, to put this in some kind of perspective.

The section "Economic Projections Without Spring Creek" is quite thin, has no assumptions spelled out, is very general and concludes that Sheridan County would have fiscal problems even without the proposed Spring Creek Mine. From what I know about the Coal Town II model, your write up in this section is either dishonest, or is not informed. You confuse assumptions possible with conclusions. The model assumes, for example, increasing ancillary employment generally (which is a national phenomenon), which has little to do with likely increasing ancillary employment from mining. Do you assume other new mines coming on line, or do you assume no new mines? In general, this section seems confused, flawed and deeply subject to question.

As indicated earlier, I have a lot of problems with your economic impacts draft, beginning on page III-23. You need another scenario, with a new town in Big Horn County. It would be easy to provide this, using the Coal Town model. You need to more carefully sort out the specific impacts of Spring Creek since it is apparently tangled up with other mining activity in your draft. This is a problem in your employment section. In general, you do not make use of the simulations in employment, income, taxes and expenditures, and population that have been generated by the Coal Town II model. Nor, anyplace, do you explain to the reader that you are using an intricate econometric model to come up with some forecasts that would resemble future aspects of the economy only the extent to which assumptions in the model held true. Anyhow, I think you could provide a good narrative to explain the employment, income and government expenditure data that you do present (though you should be sure to note that the model is based on Anglo population and other data has not been adapted to deal with an area like this that has a proportionately large Indian population). There should be an estimate of likely State and County expenditures in connection with the Spring Creek Mine. The fiscal impacts, including those likely in Sheridan County, should be thoroughly sorted out. There should be an adequate analysis of the likely economic impact on the Crow and the Northern Cheyenne. And the impacts of the mine shut down period should be analyzed thoroughly.

The material on mitigations between pp VIII-41 and 45 is interesting and informative in places and draws out some of the issues on mitigating economic impacts. This is the best economics section in the EIS, but there are problems in organization since the reader generally would expect to find this section in the chapter on mitigating measures.

In summary, the economic analysis contained in this document should be re-done both to put decision-makers in the position of being able to discern the probable economic impacts of this proposed mine and to comply with federal and State environmental law and the Montana Constitution. As the former lead economist on this EIS I know the extent to which this document is permeated by political influence and material that is simply

LETTER 31

H The Coal Town II model does not assume generally increasing ancillary employment. Instead, ancillary employment is projected using a dynamic system of equations whose independent variables are based on the theoretical relation between economic base analysis and central place theory. The coefficients were estimated, using ordinary least squares on a data base of 181 Northern Great Plains counties for 1971-74 (Temple, 1978).

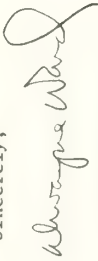
See also Appendix I-3.

Your comments have been noted.

LETTER 31

Indefensible professionally. Further, if this document is a model for the Northern Powder River Basin EIS, currently underway for Interior and the State of Montana by the same people who prepared the Spring Creek draft, it seems certain that the future to be faced by Interior and the State of Montana is one of lengthy court battles.

Sincerely,



Dwayne Ward, Ph.D.
Consulting Economist
537 Broadway
Helena, Montana 59601

DW/jb
(copy)

NORTHERN ENERGY
RESOURCES COMPANY
529 J.W. THIRD AVENUE
PORTLAND, OREGON 97204
TELECOPIER 503-243-4319
TELEPHONE 503-243-4435



LETTER 32

Mr. Craig Howard
November 17, 1978
Page 2

SPRING CREEK COMPANY'S RESPONSE TO COMMENTS

November 17, 1978

Mr. Craig Howard
Spring Creek Coordinator
Department of State Lands
State of Montana
Capitol Station
Helena, Montana 59601

SUBJECT Response to written comments on the Draft Environmental Statement for the Proposed Mining and Reclamation Plan, Spring Creek Mine, Big Horn County, Montana
(As amended on August 1-2, 1978)

Dear Mr. Howard:

In behalf of Spring Creek Coal Company, Northern Energy Resources Company ("NERCO") herewith submits its response to certain comments received by the Northern Powder River Basin EIS Team in connection with the Draft Environmental Statement ("DES") prepared in conjunction with the Proposed Mining and Reclamation Plan for the Spring Creek Mine, Big Horn County, Montana. We appreciate your cooperation in making available the comments received as of November 1, 1978, and we appreciate this opportunity to respond to those comments.

You will note that we have not addressed all of the comments received, nor have we given equal emphasis to each of our responses. Many of the concerns expressed by the commenters have been largely, if not completely, mitigated by Spring Creek Coal Company's election to seek approval of the "Central Field Mine Plan," as summarized in Chapter VIII of the DES and as fully developed in Amendment One to the Spring Creek Mining Permit Application submitted to the Montana Department of State Lands and the Office of Surface Mining on August 1-2, 1978. To the extent that the amended mining and reclamation plan, our earlier comments and other actions taken by Spring Creek Coal Company have earlier addressed the commenters' concerns, we have here abbreviated our remarks. It is our hope that the Final Environmental Impact Statement will appropriately reflect the steps taken or being taken to resolve such concerns.

While the attached comments are brief, it is our hope that they will assist you in preparing a final and well-reasoned assessment of the environmental impacts associated with the Spring Creek mining and reclamation operation.

If we may be of further assistance as you finalize this important decision-making tool, please contact us.

Yours sincerely,

WWL/DMF/pdg
Enclosure

Spring Creek Coal Company's response to comments on the Draft Environment Statement for the Proposed Mining and Reclamation Plan, Spring Creek Mine, Big Horn County, Montana as amended on August 1-2, 1978

LETTER 32

As a means to that end and as indicated in the April 13, 1978 letter included in the introduction to Amendment One to the Spring Creek Mining Permit Application, Spring Creek Coal Company has taken the initiative on the environmental issues. By scaling down the proposed action, we realize that the development will proportionately decrease the environmental impacts and meet energy needs. The amended application therefore is for a total of 184,000,000 recoverable tons under contract, which calls for production to reach 7,000,000 tons annually, "...as compared to the [original] application calling for recovery reaching 243,000,000 tons (10,000,000 tons annually)."

Also, any production beyond the contracted 184 million tons of coal is only under option for sale in the event production exceeds the 7 million ton-per-year expectation.

A. PROPOSED ACTION

Comment: The United States Department of the Interior, Bureau of Mines, made the following comments:

"...the intent of this PURPOSE Section is to cover the advantages of this potential coal production. If that is the case, it should be strengthened especially to stress the Nation's future needs for energy from coal."

"Spring Creek Coal Company committed itself on two contracts to deliver 12 million tons of coal a year. The proposed mining plan considers production of 10 million tons a year. This difference should be clarified."

Spring Creek Coal Company's Response:

We would agree with the comment expressed by the Bureau that the purpose of this proposal is to meet national imperatives for the maintaining or improving of our standard of living, and to our continual economic growth in an increasingly competitive world market.

We believe that low-sulfur coal produced by the proposed Spring Creek Mine will serve the nation's growing need for domestic energy alternatives to imported oil, as well as provide a fuel which is both environmentally and economically attractive. In addition, the most rigorous environmental and reclamation standards will be maintained throughout the mine's development and production phases.

Clearly, the President of the United States has provided the needed leadership in establishing the objectives of an energy program, but the responsible development of local resources to reach national goals demands sacrifice and cooperation. Spring Creek Coal Company is committed to working in the public interest by meeting the diverse informational needs and regulatory requirements of local, state and federal offices.

B. HYDROLOGY

Comment: Some comments expressed concerns for the impact of the project on water resources (perennial flowing waters).

Spring Creek Coal Company's Response:

We have initiated extensive hydrological studies of the project area to determine the hydrologic regime. In Amendment One to the Spring Creek Mining Permit Application submitted to the Montana Department of State Lands and the Office of Surface Mining on August 1-2, 1978, the areas of concern are not to be mined.

C. VEGETATION AND WILDLIFE

Comment: The United States Department of the Interior, Fish and Wildlife and the State of Montana, Department of Fish and Game, both raised issues that reflect the concern for complex ecological interrelationships and the interdependency of plant and animal species.

Spring Creek Coal Company's Response:

These complex ecological matters and mitigation of impacts to them are addressed and examined in detail in the Planting and Revegetation and Wildlife sections of Amendment One of the Spring Creek Mining Permit Application, submitted August 1-2, 1978.

- 3 -

LETTER 3?

D. SOCIOLOGY AND ECONOMICComment

Comments from a variety of individuals and agencies have pointed out the inadequate environmental assessment of the social and economic impacts.

Spring Creek Coal Company's Response:

While reasoning may differ, we are in agreement that these impacts have not received the objective analysis necessary to produce an environmental statement that can serve as a useful decision-making tool. We have been given to understand that just such a complete and fair study is being conducted which will offer a more balanced presentation of the entire spectrum of factors, which makes up "the public interest."

E. CULTURAL RESOURCES

Comment: Various comments questioned the adequacy of the survey of sites eligible for inclusion in the National Register of Historic Places, and noted the incomplete analysis of the Native American culture and project impacts.

Spring Creek Coal Company's Response:

As indicated by the July 12, 1978 letter in the Draft EIS, an intensive field inventory is in progress and a final report will be published on all inventories, mitigation design and plan, and data recovery no later than January 15, 1977 for review by the USGS, BLM, DSL, and SHPO.

F. AIR QUALITY

Comments: The Tri-County Ranchers Association, Montana State Department of Health and Environmental Sciences, and the City of Gillette have questioned the Draft Environment Statement on the effect of the proposal on air quality.

Spring Creek Coal Company's Response:

It is especially interesting to note that the potential for health hazards specifically cited in the Draft Environmental Statement which seems highly overdrawn, was just as specifically refuted by the Montana State Department of Health and Environmental Sciences, along with an apparent bias that

- 4 -

resulted in other errors. It is clear that the "...personal opinions on the desirability of any project..." prevented the presentation of "...an informed, objective view of the proposed project and its affect on the environment." Of course, the extent of the health problems and air quality impacts encountered in underground mining are not applicable to surface mining. Moreover, the size and scope of the project has been reduced affecting the impact on air quality.

Finally, the Air Quality data are contained in the Application to the U.S. Environmental Protection Agency for Spring Creek Mine, Section IV, "Fugitive Dust and Gaseous Emissions Inventory", includes the calculations used to derive the fugitive dust (coal and non-coal) and the gaseous emissions resulting from the equipment and processes employed at the mine. A summary, information table and bibliography are included. The data and mitigation measures are adequate to meet existing standards and regulations.

D. PUBLIC HEARINGS: SUMMARY OF PRINCIPLE COMMENTS

Public hearings on the draft environmental statement were held at Decker, Montana, and Sheridan, Wyoming, on September 20 and 21, 1978, respectively. A summary of testimony at the hearings and references to responses already made to similar concerns in the written comments is presented below. Transcripts of the hearings are on file at the Montana Department of State Lands, 1625 11th Ave., Helena, Montana 59601; the office of the Northern Powder River Basin EIS task force, 2601 1st Ave. North, Billings, Montana 59101; and the U.S. Geological Survey, Box 25046, Mail Stop 701, Denver Federal Center, Denver, Colorado 80225.

Testimony was presented by 18 individuals, nine on each of the two days of hearings. Ten individuals, not including a representative of the company, expressed approval of the proposed Spring Creek mine on various grounds including the following:

- . Big Horn County would benefit from an increased tax base.
- . Sheridan and Sheridan County would benefit from the economic stimulus and additional employment opportunities directly or indirectly associated with the new mine.
- . Land in the proposed mine area has not supported viable ranching or farming operations in the past, and may be improved through reclamation efforts following mining.
- . Coal produced from the mine would supply additional energy to help meet national needs.

Testimony expressing concern for the environment and for adverse social and economic impacts, as well as comments pointing out apparent inadequacies in the DES, are grouped according to major subjects of concern.

Alluvial valley floor

One person suggested that the Spring Creek area might fall within the definition of an alluvial valley.

Reference: See Appendix S.

Hydrology

Three people expressed concern that the quality of water in the Tongue River would be degraded as a result of mining at Spring Creek and as a result of cumulative effects with other potential mines. One person questioned how much mercury might be added to the Tongue River from mine spoils.

Reference: See underlined paragraph on page III-5, and responses to letters 8(A, B), 11(I), and 23 (G-N, W, GB, BBB).

The limits of analyses of cumulative impacts are discussed in response to letter 28 (C). Regional cumulative impacts that include potential future mines will be assessed in the Northern Powder River Basin Regional coal EIS.

Air Quality

One person expressed concern about the anticipated decrease in air quality due to projected increases in dust from the Spring Creek mine and from trains transporting coal from the mine.

Reference: See responses to letters 9 (I-1, I-2), 18 (A-G), 25 (C, E), and 29 (A-C).

Reclamation potential, Vegetation, Wildlife, and Land Use

Three speakers referred to potential problems with and the importance of complete reclamation to the future uses of the area. One speaker asked how long the mine area would remain "a wasteland."

References: Written comments were received which raised more specific questions regarding the potential success of and reestablishment of reclamation, vegetation, wildlife, and land use; see letters 3 (A), 9 (A), 10 (A, C), 11 (C-F), 23 (PP, RR, DDD), and 29 (E).

Sociology

One speaker noted that the EIS evaluation of potential social impacts in the area of the proposed mine was based on studies that may be out of date (1974, 1975), and that current attitudes of local ranchers are not considered. In addition, it was noted that there was a lack of analysis in the DES regarding social and cultural impacts that might result from mining on the Northern Cheyenne Indians.

Response: In regard to the up-to-dateness of sociological information considered in the preparation of the DES; the analysis was based on the information available at the time. As noted on page II-48 (footnote) additional information on Sheridan County has recently been assembled which was used in preparing this final environmental statement.

See letters 23 (V, VV) and 28 (A, B).

Economics

Four members questioned various aspects of the analysis of anticipated economic impacts presented in the draft. It was noted that the DES makes insufficient analysis of employment opportunities arising from the Spring Creek mine to the Northern Cheyenne Indians population, as well as an insufficient analysis of economic impacts to the Northern Cheyenne Reservation.

References: See letters 28 (B) and 31 (E).

One speaker suggested the need for additional analysis of future economic effects of the new mine; and another speaker asked what measures could be taken to alleviate problems associated with growth of population and economic stimulation.

References: See letters 31 (A-H), 16 (A), 29 (H-J, M), and 30 (C).

Transportation

One speaker expressed concern over the prospect of another railroad grade crossing serving the Spring Creek mine, or with its attendant additional delays and the increased danger of accidents.

References: See letters 22, 26 (A), 29 (F, G).

Other Concerns

One speaker noted that it cannot be "assumed", as said in the DES, that the company would construct the power line so as to avoid harm to eagles and other raptors.

Reference: See letter 11 (A).

Another speaker referred to a recent projection made by the Department of Energy, which forecasts large-scale increases in coal mining in the Northern Powder River basin and in other areas. In view of this forecast, a further assessment should be made of the cumulative effects of the Spring Creek mine and other potential mines in the region.

References: See letters 17 (A), 23 (WW), and 28 (C, D).

One speaker noted that in discussions, in the DES, of anticipated social and economic impacts, there is very little indication of the significance of those impacts--whether the mine would add a small, medium, or large increment to already existing impacts.

Response: The task force has attempted to keep the matter of significance as a central concern in making its analyses of anticipated impacts. Where data permit, some indication of significance (how bad? or how good?) is usually given. This requires that the projected impacts be viewed in perspective.

It is not always possible to measure significance by numbers, or even by the more general terms, small, medium, or large. Furthermore, not everyone views the anticipated impacts with the same perspective, given the same data.

CHAPTER X

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APPENDIXES

CHAPTER XI

APPENDIXES

Appendix A.--Overburden characteristics at the Spring Creek mine

The following discussion on the chemical and physical characteristics of the overburden in the Spring Creek area is based on data provided by the company. A summary of the overburden traits is presented in table A-1.

a. pH

The distribution of overburden with excessive pH values shows a high degree of areal and vertical variability throughout the lease area. Ten of the 20 test holes interrupted layers of pH 8.8 or greater, and 3 of the holes (317, 387, and 388) intercepted two such layers. High pH layers were found from 7.5 to 188.7 feet in depth. Eight of the holes were located in the eastern part of the lease area. Four test holes (317, 383, 387, and 392) yielded cores having a pH greater than 9.0, and all of these holes were located in the eastern part of the lease area.

b. Soluble salts

The overburden throughout the lease area is near-saline (mean electrical conductivity = 3.82 mmhos/cm), and the overburden in the eastern two-thirds of the lease area is saline (table below). Soils whose conductivity exceeds 4.0 mmhos/cm are classified as saline (Richards, 1954).

(The State suspect level for Soluble Salts is 4-6 mmhos/cm)

Drill hole No.	Electrical conductivity (mmhos/cm)
310-----	5.47
348-----	5.19
370-----	6.47
376-----	5.66
382-----	6.62
383-----	4.42
388-----	4.16
392-----	4.89

TABLE A-1.--Overburden traits of the Spring Creek coal field,
summary of drill hole averages

Overburden Trait	Arithmetic Mean ¹	Range	State Suspect Level ²	Comments
pH, paste	8.20	7.74-8.87	8.8-9.0	Drill hole #392 exceeds suspect level
Soluble Salts, mmhos/cm	3.82	1.37-6.62	4-6	Drill holes above suspect level identified in text
Na, meq/l	25.87	10.82-39.96		
Ca, meq/l	2.95	0.30-8.26		
Mg, meq/l	9.88	1.13-30.70		
SAR	23.29	4.34-35.32	12	Overburden mean above suspect level
ESP	13.45	3.8-25.5		
P, available, ppm	6.82	3.0-11.2		
K, available, ppm	293.39	208-343		
Nitrate, ppm	17.29	2.4-73.5	Federal livestock threshold 50	Drill holes #370 and #390 exceed suspect level
Ammonium, ppm	30.62	9.3-48.9		
B, Water soluble, ppm	0.69	0.30-1.97	8	All drill holes below suspect level
Mo, NH ₄ Oxylate soluble, ppm	0.76	0.26-1.69	0.3	Overburden mean above suspect level
Se, available, ppm	0.026	0.26-1.69	2.0	All drill holes below suspect level
Cu, DTPA ex- tractable, ppm	5.51	2.6-9.0	40	All drill holes below suspect level
Fe, DTPA ex- tractable, ppm	343.98	140-585		
Mn, DTPA ex- tractable, ppm	34.21	14.0-67.7	60	Drill holes #335, #370, and #382 exceed suspect level
Zn, DTPA ex- tractable, ppm	8.77	3.14-23.17	40	All drill holes below suspect level
Ni, DTPA ex- tractable, ppm	6.82	3.01-9.82	1	All drill holes above suspect level
Cd, DTPA ex- tractable, ppm	0.20	0.20-0.20	0.1-1	All drill holes above suspect level
Pb, DTPA ex- tractable, ppm	4.83	2.9-7.8	15-20	All drill holes below suspect level
Hg, Total, ppb	67.85	33.0-115.0	400-500	All drill holes below suspect level
Clay, %	28.35	24.8-37.4	40	All drill holes below suspect level

¹These values differ from those submitted by applicant which were calculated as a weighted mean.

²These levels are guidelines used by the State in evaluating the suitability of overburden as a revegetation medium.

The 60 feet of overburden immediately above the coal was non saline in all parts of the lease area; the surface 5 and surface 10 feet of the overburden were moderately saline (average electric conductivities of 11.79 and 10.67 mmhos/cm, respectively). The highly saline material was found in individual intervals as follows:

Drill hole No.	Interval (ft)		Electrical conductivity (mmhos/cm)	Drill hole No.	Interval (ft)		Electrical conductivity (mmhos/cm)
	From	To			From	To	
310---	11.2	19.6	15.6	382---	1.5	11.5	21.1
335---	3.9	6.8	20.0	383---	1.0	3.0	45.0
348---	1.0	3.8	17.2	383---	3.0	11.0	19.4
348---	3.8	5.8	15.9	386---	1.5	2.5	18.0
376---	1.0	3.0	19.1	387---	8.0	11.6	15.3
376---	3.0	10.0	15.1	388---	1.5	3.0	22.6
				390---	1.0	10.0	16.1

c. Nitrate

Nitrate concentration varied considerably across the area. Fourteen drill holes, mostly in the eastern portion of the leasehold, intercepted layers with 10 ppm or more. (The Federal drinking water standard is 10 ppm.) Six additional test holes, all in the eastern part of the leasehold, intercepted layers that contained 50 or more ppm (table below).

(The Federal threshold for stock water use is 50 ppm nitrate)

Drill hole No.	Interval (ft)		Nitrate (ppm)	Drill hole No.	Interval (ft)		Nitrate (ppm)
	From	To			From	To	
348---	1.0	3.8	54	386---	17.8	21.0	184
348---	3.8	5.8	125	386---	21.0	31.0	80
348---	5.8	8.0	63	388---	7.5	17.5	106
348---	12.2	22.2	63	388---	17.5	23.0	145
370---	10.0	17.5	153	388---	23.0	28.0	188
370---	17.5	23.9	67	388---	30.6	35.4	135
370---	26.0	36.0	81	390---	1.0	10.0	51
383---	1.0	3.0	132	390---	10.0	20.0	318
386---	7.8	17.8	140	390---	20.0	30.0	290

The highest concentrations of nitrate occur near the surface, but could also occur at depth. Drill holes 387 and 389 intersected seven and nine layers of nitrate concentrations respectively.

d. Manganese

Although the overburden average of 34.21 ppm manganese is less than the state suspect level, three drill holes (table below) averaged more than 60 ppm.

(The State suspect level for Manganese is 60 ppm)

Drill hole No.	DTPA extractable Mn (ppm)
335-----	62.5
370-----	67.7
382-----	60.2

Intervals containing more than 60 ppm also occurred in drill holes that averaged less than the suspect level (table below).

(The State suspect level for Manganese is 60 ppm)

Drill hole No.	Interval (ft)		DTPA extractable Mn (ppm)	Drill hole No.	Interval (ft)		DTPA extractable Mn (ppm)
	From	To			From	To	
308---	1.4	6.6	61.6	376---	1.0	3.0	163.2
308---	26.6	36.6	67.6	376---	10.0	13.5	126.0
310---	22.3	32.3	96.4	376---	13.5	15.5	196.0
310---	32.3	38.0	96.8	379---	1.0	7.0	80.8
317---	1.0	3.8	67.2	379---	12.0	16.0	76.4
317---	3.8	5.5	180.0	380---	1.0	11.0	82.0
317---	6.9	16.9	79.2	380---	11.0	21.0	162.0
335---	1.0	3.9	128.0	380---	21.0	28.5	118.0
335---	3.9	6.8	77.2	380---	28.5	38.5	78.8
335---	6.8	15.5	120.0	380---	38.5	48.5	73.2
335---	15.5	18.4	66.4	381---	1.0	6.6	102.0
335---	18.4	26.3	120.0	381---	6.6	11.0	104.0
335---	30.8	40.8	74.8	381---	11.0	13.4	60.4
370---	1.5	10.0	78.8	382---	1.5	11.5	60.4
370---	17.5	23.9	104.0	382---	11.5	21.5	125.2
370---	36.0	41.9	61.6	382---	21.5	31.5	130.0
370---	41.9	46.1	104.0	382---	36.0	42.2	86.0
				388---	1.5	3.0	95.2

Intervals containing more than 60 ppm manganese frequently occurred at or near the surface, and all such intervals were within 50 feet of the surface. These high manganese concentrations showed no areal pattern, occurring throughout the study area.

e. Sodium-adsorption-ratio (SAR)

Except for three drill sites (308, 335, and 270), the mean SAR values exceeded state standards. In the drill holes where the SAR level exceeded state standards, layers of overburden with a lower SAR were common at or near the surface, and in all cases occurred at depths less than 50 feet.

f. Molybdenum

Concentrations of plant-available molybdenum in the overburden has an arithmetic average of 0.76 ppm. Weighted mean averages for individual columns (sections) of overburden ranged from 0.26 to 1.69 ppm of molybdenum. Overburden columns averaging more than 1.0 ppm molybdenum were as follows:

(The State suspect level for Molybdenum is 0.3 ppm)

Drill hole No.	Available molybdenum (ppm)
384-----	1.28
386-----	1.06
387-----	1.69
390-----	1.05

In all 20 test holes showing molybdenum concentrations, some layers exceeded state levels. In general, the molybdenum content of the overburden increased to the east across the leasehold. Less than 5 percent of the overburden volume had more than 2.0 ppm molybdenum (table following):

(The State suspect level for Molybdenum is 0.3 ppm)

Drill hole No.	Interval (ft)		Available molybdenum (ppm)
	From	To	
348-----	34.9	44.9	2.7
387-----	1.0	2.0	18.2
387-----	2.0	8.0	3.2
387-----	11.6	17.2	3.2
387-----	26.6	30.1	2.2
387-----	81.3	84.2	2.4
387-----	123.0	133.0	2.2
387-----	147.9	157.9	2.3
387-----	157.9	167.9	2.3
387-----	186.0	188.7	2.1
389-----	81.8	87.7	2.1
389-----	127.5	133.5	2.2
392-----	27.6	37.6	2.4
392-----	47.6	57.6	2.2

g. Nickel

The average DTPA extractable nickel concentration for the overburden was 6.82 ppm and measured concentrations ranged from 3.01 to 9.82 ppm. All 20 test holes intercepted one or more layers of high nickel concentrations. In several holes (308, 310, 317, 335, 376, 379, 380, 381, 382, and 390), all of the overburden was above the State suspect level. Some of the higher nickel concentrations are listed as follows:

(The State suspect level for Nickel is 1.0 ppm)

Drill hole No.	Interval (ft)		Nickel (ppm)		Drill hole No.	Interval (ft)		Nickel (ppm)
	From	To				From	To	
308----	58.6	66.2	22.0		381----	98.9	104.5	17.2
310----	53.6	63.3	11.4		382----	44.9	51.0	23.1
317----	45.7	47.7	19.2		383----	34.9	42.9	11.4
335----	60.8	70.8	15.2		384----	45.0	53.5	18.0
348----	100.6	105.7	13.4		386----	84.8	86.8	12.4
370----	41.9	46.1	7.6		387----	116.5	123.0	21.2
376----	60.9	72.0	15.8		388----	77.0	87.0	12.2
378----	73.3	79.1	11.4		389----	81.8	87.7	18.8
379----	104.5	112.4	13.7		390----	33.0	43.0	11.2
380----	106.0	110.0	21.6		392----	118.8	123.7	10.4

Most of the higher nickel concentrations occurred at or near the bottom of the drill holes, near the top of the coal beds. However, other concentrations occurred midway down the overburden column.

h. Cadmium

Cadmium concentrations in the overburden were nearly constant at 0.2 ppm.

Physical and chemical characteristics of overburden,
Spring Creek coal field. Volume weighted averages for test holes

Appendix A

	Test hole No.									
	<u>308</u>	<u>310</u>	<u>317</u>	<u>335</u>	<u>348</u>	<u>370</u>	<u>376</u>	<u>378</u>	<u>379</u>	<u>380</u>
PH, PASTE	8.00	8.05	8.35	7.81	8.26	8.21	8.31	8.33	8.35	8.57
SATURATION PERCENT	44.91	41.20	68.69	40.01	60.72	49.39	49.34	47.45	51.56	54.22
SOLUBLE SALTS, MMHOS/CM	1.71	5.47	3.45	3.58	5.19	6.47	5.66	3.39	2.95	3.11
NA, MEQ/L	10.82	39.96	24.58	12.08	42.05	36.31	36.43	21.16	24.96	19.92
CA, MEQ/L	2.18	5.44	1.59	8.26	1.66	3.42	4.64	3.76	0.91	2.87
MG, MEQ/L	7.69	13.87	5.02	20.38	3.85	21.02	12.68	12.62	2.99	10.48
SAR	5.13	21.81	34.01	4.34	34.54	10.51	14.57	23.05	30.91	19.74
NA, WATER, MEQ/100G	0.49	1.63	1.43	0.47	2.75	1.85	1.96	0.99	1.35	1.03
NA, NH4AC, MEQ/100G	1.07	3.36	5.15	1.05	5.79	3.27	3.46	2.62	4.23	3.24
CEC, MEQ/100G	15.87	12.35	15.49	15.39	15.21	23.81	19.45	18.06	17.76	22.22
ESP	3.79	14.76	25.53	4.23	19.98	5.77	8.45	10.70	17.63	11.07
P, AVAILABLE, PPM	3.32	3.78	11.20	4.86	9.25	10.43	3.62	5.80	5.06	5.81
K, AVAILABLE, PPM	208.70	244.55	289.06	228.95	338.28	291.00	326.21	269.24	332.13	270.50
NITRATE, PPM	4.34	4.53	8.15	8.20	23.78	54.54	4.67	16.19	2.39	4.30
AMMONIUM, PPM	24.81	30.58	18.37	12.98	32.37	10.47	31.01	45.48	48.91	36.14
B, WATER SOLUBLE, PPM	0.40	0.30	0.52	0.59	1.97	0.67	0.55	0.69	0.61	0.50
MO, NH4OXYLATE SOLUBLE, PPM	0.61	0.53	0.86	0.54	0.92	0.58	0.39	0.26	0.45	0.26
SE, AVAILABLE, PPM	0.029	0.025	0.020	0.012	0.025	0.025	0.025	0.025	0.026	0.033
CU, DTPA EXTRACT, PPM	6.58	5.57	8.94	7.77	5.46	3.85	6.85	4.23	5.15	4.51
FE, DTPA EXTRACT, PPM	165.52	139.72	479.19	347.65	360.09	214.31	509.75	277.70	361.10	335.34
MN, DTPA EXTRACT, PPM	41.39	37.43	27.96	62.45	23.35	67.71	43.45	26.50	25.34	57.16
ZN, DTPA EXTRACT, PPM	6.99	6.74	5.94	3.75	5.94	4.81	13.26	4.65	6.92	23.17
NI, DTPA EXTRACT, PPM	5.37	6.10	7.11	6.05	8.34	3.01	9.07	4.49	8.08	6.24
CD, DTPA EXTRACT, PPM	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
PB, DTPA EXTRACT, PPM	4.50	3.65	4.49	4.57	5.12	4.47	7.76	3.73	5.82	5.23
HG, TOTAL, PPB	32.88	36.60	42.56	39.26	74.25	56.78	91.34	40.76	63.87	52.57
VERY COARSE SAND (-2+1 MM), %	0.24	1.54	1.85	1.40	1.16	2.34	0.73	0.91	1.46	0.23
COARSE SAND (-1+0.5 MM), %	0.57	2.68	2.80	3.69	1.35	2.14	0.90	1.18	1.94	0.67
MEDIUM SAND (-0.5+0.1 MM), %	14.91	7.55	6.72	5.73	2.50	3.76	2.18	3.81	2.89	11.30
VERY FINE SAND (-0.1+0.05 MM), %	15.11	8.78	13.06	8.38	4.80	7.87	6.42	8.23	3.72	11.38
SILT (-0.05+0.002 MM), %	44.35	52.17	49.78	52.85	60.89	56.86	61.00	59.35	60.25	49.42
CLAY (-0.002 MM), %	24.83	27.27	25.77	27.99	29.29	27.03	28.77	26.52	29.73	27.00

Appendix A (cont.)

Overburden traits of the Spring Creek lease area
volume weighted averages for test holes

	Test Hole No.											
	381	382	383	384	386	387	388	389	390	392		
PH, PASTE	8.30	7.79	8.31	8.03	8.47	8.19	7.94	7.74	7.96	8.87		
SATURATION PERCENT	54.21	39.51	59.29	53.66	88.22	53.48	45.49	57.39	95.99	71.50		
SOLUBLE SALTS, MMHOS/CM	3.01	6.62	4.42	2.60	2.47	3.89	4.16	2.08	1.37	4.89		
NA, MEQ/L	26.20	30.81	32.99	19.88	19.80	23.62	34.56	18.72	11.94	30.51		
CA, MEQ/L	1.22	8.18	2.36	1.05	0.52	3.91	1.90	0.84	0.30	4.05		
MG, MEG/L	3.52	30.70	6.43	3.49	1.39	15.97	8.06	1.13	1.29	15.01		
SAR	30.30	15.42	32.04	18.26	35.32	26.46	30.93	24.90	29.60	23.92		
NA, WATER, MEQ/100G	1.44	1.16	1.88	1.00	1.64	1.32	1.63	1.13	2.48	1.02		
NA, NH4AC, MEQ/100G	5.36	2.54	4.49	3.00	6.00	3.80	3.77	3.86	3.26	6.59		
CEC, MEG/100G	18.48	16.18	18.41	20.30	17.26	22.91	16.08	23.33	20.67	23.55		
ESP	20.97	10.39	14.82	9.03	24.99	12.40	14.30	12.20	4.95	23.11		
P, AVAILABLE, PPM	3.02	5.47	8.64	7.83	7.49	10.68	9.40	5.47	6.62	8.58		
K, AVAILABLE, PPM	331.22	292.87	314.09	329.54	293.84	320.85	285.07	342.50	287.25	271.91		
NITRATE, PPM	3.78	7.93	13.79	3.58	37.58	12.34	46.03	8.65	73.45	7.49		
AMMONIUM, PPM	40.63	43.96	32.00	38.61	35.67	42.53	31.26	37.65	9.25	9.71		
B, WATER SOLUBLE, PPM	0.65	0.56	0.56	0.50	0.55	0.68	0.52	0.68	0.88	1.36		
MO, NH4OXYLATE SOLUBLE, PPM	0.56	0.83	0.76	1.28	1.06	1.69	0.89	0.97	1.05	0.73		
SE, AVAILABLE, PPM	0.026	0.030	0.025	0.025	0.026	0.025	0.025	0.029	0.044	0.025		
CU, DTPA EXTRACT, PPM	7.81	9.04	4.59	3.43	2.60	5.34	4.60	5.37	6.95	1.60		
FE, DTPA EXTRACT, PPM	584.87	511.20	329.85	238.39	283.58	415.35	380.74	381.82	318.03	245.41		
MN, DTPA EXTRACT, PPM	36.43	60.18	22.83	22.42	18.08	16.37	28.93	21.87	30.44	13.99		
ZN, DTPA EXTRACT, PPM	14.73	20.81	7.15	11.54	5.70	7.27	8.65	5.52	8.66	3.14		
NI, DTPA EXTRACT, PPM	9.62	9.82	6.83	5.85	5.90	8.73	6.87	8.71	6.91	3.25		
CD, DTPA EXTRACT, PPM	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20		
PB, DTPA EXTRACT, PPM	5.62	6.01	3.93	4.13	2.91	4.96	4.96	5.24	5.86	3.73		
HG, TOTAL, PPB	97.40	108.73	62.41	60.69	62.88	80.15	84.21	100.14	115.23	54.31		
VERY COARSE SAND (-2+1 MM), %	0.96	1.17	1.22	0.54	1.18	2.94	2.76	1.07	0.68	0.70		
COARSE SAND (-1+0.5 MM), %	1.15	2.09	1.55	1.01	1.26	2.69	2.30	1.46	1.35	1.44		
MEDIUM SAND (-0.5+0.1 MM), %	1.96	6.90	3.24	3.17	3.17	5.75	5.63	9.57	3.01	20.92		
VERY FINE SAND (-0.1+0.5 MM), %	6.68	7.34	8.04	11.81	12.46	9.25	9.21	8.04	4.48	21.16		
SILT (-0.05+0.002 MM), %	60.88	49.52	57.23	55.40	60.02	47.47	53.15	46.62	53.06	34.23		
CLAY (-0.002 MM), %	28.37	34.39	28.72	27.94	21.91	32.48	26.96	33.18	37.43	21.46		

Appendix B. -- Summary of Ground Water Quality, November 1976

Parameters	Alluvial Aquifers		Anderson-Dietz	
	Wells		Coal Aquifer	
	329 P	365 D	320 D	326 P
General Characteristics				
pH, Field	7.7	7.4	7.8	7.9
Specific conductance mmhos at 25°C, field	2250	2800	3550	2750
Temperature °C	11.5	11.9	14.8	13.0
Major Cations				
Calcium mg/l	190	160	30	18
Magnesium mg/l	230	290	12	6
Potassium mg/l	10	10	13	10
Sodium mg/l	130	240	800	700
Sodium Adsorption Ratio	1.6	2.6	31	37
Major Anions				
Bicarbonate mg/l	1100	1100	1200	1800
Chloride mg/l	7	8	8	10
Fluoride mg/l	.48	.59	.53	.61
Sulfate mg/l	770	1200	860	130
Nitrate mg/l	1.0	1.0	3.1	2.2
Trace Metals				
Cadmium mg/l	< .01	< .01	< .01	< .01
Chromium mg/l	< .02	< .02	< .02	< .02
Lead mg/l	< .02	< .02	< .02	< .02
Mercury mg/l	< .001	< .001	< .001	< .001
Selenium mg/l	< .005	< .005	< .005	< .005
Total Phosphorus mg/l	.30	.29	.41	.26
Iron, Dissolved mg/l	.08	.05	.10	.10
Iron, Total mg/l	1.0	3.6	.27	1.1
Manganese, Dissolved	< .01	< .01	< .01	.02
Zinc, Dissolved mg/l	.13	.13	.16	.11

Appendix D-1. -- Atmospheric particulate high-volume sampling
 Decker-Shell¹ (Youngs Creek), and Spring Creek
 Units: ug/m

Date	Shell CIRL Site	Spring Creek Site	State- Decker Mine	Shell CIRL Site	Spring Creek Site	State- Decker Mine	Shell CIRL Site	Spring Creek Site	State- Decker Mine
(1975)									
Oct 3	47.8		May 6	11.0		31.3	Nov 2	11.4	30.4 95.1
9	12.0		12	12.0		241.3	6	7.9	
15	9.3		18	40.0	40.8	109.0	8		19.5 149.6
22	3.1		24			90.5	13	16.0	
28	2.7		26	10.0	17.8		14		95.1
			30	24.0		20.9	15		36.0
Nov 1	8.0						20	12.5	36.0 102.1
7	8.0		June 5	34.0	37.6		25	4.1	
14	2.0		11	22.0	31.7	194.9	26		13.4 109.1
20	4.0		17	6.0	11.2	23.2			
26	-1.0		23	15.0	14.9	206.5	Dec 1	5.4	
			29	17.1	20.3	38.3	2		8.9
Dec 2	-1.0	20.5					7	4.5	
8	8.0	15.7	July 5	34.0	37.6		8		13.5
14		14.5	11	22.0	31.7	194.9	13	9.4	
16	1.0		12		23.1		17	5.4	
20	1.0		17			46.4	20		38.4
25	4.0		22		24.2		23	5.1	
31	2.0		23	25.0		128.8	28		12.4
			29	31.3	35.8	134.6	31	1.2	
(1976)									
			Aug 4	12.9	16.5	81.2	(1977)		
Jan 7	9.0		10	14.7	24.4	171.1			
13	2.0		16	22.9	29.6	161.2	Jan 4		10.0
17	4.0		22	27.9	21.8	125.3	6		10.9
19		236.2	28	15.0	27.9	99.8	7	6.6	
25	7.0	19.3					13	6.1	13.1
31	5.0	98.8	Sept 3	7.1	47.2	187.9	19	3.9	6.1
			9	14.3	21.1		25	7.4	11.0
Feb 6	10.0	34.9	15	15.9	24.0	65.0	28	6.6	
12		42.2	21	13.9	26.1	40.6	31		12.8
13	5.0		25	29.7					
18	18.0	85.6	27		16.3	26.7	Feb 4	8.1	
24	7.0						6		13.2
25		61.5	Oct 3			74.2	11	7.4	
28	3.0		4		14.9		12		11.6
			5	9.6			17	2.8	
March 1		25.3	9	12.3	16.6	51.0	23	3.3	
6	3.0		15	12.9	17.6				
7		21.7	21	31.1	15.4	42.9	March 2	10.4	
13	7.0	25.3	27		13.7	71.9	8	38.8	
19	25.0		28	7.7			14	6.6	
25	14.0						20	10.2	
31	8.0								
April 6	29.0								
10	50.0								
11		118.0							
17	8.0								
18		20.9							
24	8.0	41.8							
30	18.0	81.2							

^{1/} CIRL refers to the Crow Indian Reservation Lease

Appendix D-2. -- Atmospheric visibility in miles
 [Source: Shell Oil Company, Mining
 Ventures CIRL (Crow Indian Reservation
 Lease) Monitoring Program]

Observed Time				Visibility (Miles)	Observed Time				Visibility (Miles)
Yr	Mo	Dy	Hr		Yr	Mo	Dy	Hr	
75	10	02		---	76	04	05	1230	35
		08		---			09	1200	35
		14		---			16	1230	5
		21		30			23	1230	30
		27		25			29	1240	30
		31	1200	40		05	05	1200	30
11	06	1155		40			11	1245	10
	13	1200		40			16	0900	35
	19	1300		35			25	1140	35
	25	1230		1			28	1200	35
12	01	1330		45		06	04	1120	35
	07	1300		30			10	1040	35
	15	1300		25			16	1213	30
	19	1230		40			22	1100	20
	24	1000		40			28	1145	35
	30	1200		35		07	02	1040	20
76	01	06	1200	2			09	1120	35
		12	1300	4			16	1100	35
		16	1230	40			22	1100	35
		23	1300	35			28	1200	35
		30	1200	35		08	03	1100	35
02	05	1230		25			09	1300	35
	12	1225		35			13	1215	35
	17	1210		35			20	1400	35
	23	1155		30			27	1145	35
	27	1030		20		09	02	0845	35
03	05	1130		35			08	1100	35
	12	1120		35			14	1245	35
	18	1200		35			20	1340	35
	24	1200		35			24	1130	35
	30	1200		35					

Appendix D-3.--Theoretical maximum particulate emissions at a 10 x 10⁶ tons per year mine

* (Derived From Emission Factors Not Developed on Site) *									
EQUIPMENT & MATERIALS	TYPE OF ACTIVITY	# OF UNITS	/UNIT/YEAR KM-TONS-HOURS-	PARTICULATE EMISSION MULTIPLIER	FUEL USE		FUEL TOTALS		MAXIMUM THEORETICAL PART. EMISSION TONS
					G=GAS	D=DIESEL	G=GASOLINE	D=DIESEL	
Dragline, 56 yd ³	Stripping Overburden	1	14.91 X 10 ⁶ T	.021 Kg/T**	Electric				313.11
Coal Shovel, 30 yd ³	Coal Loading	2	4,536 X 10 ⁶ T	.021 Kg/T	Electric				95.26
Coal Drills	Drill Blast Holes	2	4,000 hr	4.54 Kg/hr	105,980 1 D		211,960 1 D		18.16
120 Ton Coal Trucks	Coal Hauling	10	86,403.3 Km	1 Kg/Km	354,654.5 1 D		3,546,545 1 D		86.40
			907200 T	.021 Kg/T					19.05
Electric Wheel Loader	Coal & Overburden Loading	1	4,000 hr	14.54 Kg/hr***	193,792 1 D		193,792 1 D		58.16
			unknown T	-----					
Overburden Shovel	Overburden Loading	1	310,716 T	.021 Kg/T	Electric				6.53
Overburden Drills	Drill Blast Holes	2	4,000 hr	4.54 Kg/hr	Electric				18.16
120 T Overburden Truck	Overburden Hauling	5	77,232 Km ⁶ T	1 Kg/Km	431,490 1 D		2,157,450 1 D		77.23
			1.056 X 10 ⁶ T	.021 Kg/T (1)					22.18
D-9 & 824 Cat (Dozer)	Reclamation, etc.	7	4,000 hr	7.27 Kg/hr	157,456 1 D		1,102,192 1 D		29.08
637 Cat Scraper	Topsoil Salvage & Spoil Hauling	3	4,000 hr	14.54 Kg/hr	257,380 1 D		772,140 1 D		58.16
			372,859 T	.021 Kg/T					7.83
16 G Cat Grader	Road Maintenance	3	4,000 hr	14.54 Kg/hr	78,728 1 D		236,184 1 D		58.16
Water Truck, 5000 gal	Water Haul Roads	2	25,744 Km	.255 Kg/Km***	20,060.5 1 D		40,121 1 D		6.56
Explosive Truck	Explosive Work	4	16,090 Km	.255 Kg/Km	6,434.5 1 G		25,738 1 G		4.10
Lube Truck	Equipment Servicing	1	6,034 Km	.255 Kg/Km	2,838.75 1 G		2,838.75 1 G		1.54
Fuel Truck	Equipment Servicing	1	6,034 Km	.255 Kg/Km	2,838.75 1 G		2,838.75 1 G		1.54
Welding Truck	Equipment Servicing	2	6,034 Km	.255 Kg/Km	5,677.5 1 G		5,677.5 1 G		1.54
Supply Truck	Equipment Servicing	1	6,034 Km	.255 Kg/Km	2,838.75 1 G		2,838.75 1 G		1.54
Hydraulic Boom Truck	Equipment Servicing	1	6,034 Km	.255 Kg/Km	2,838.75 1 G		2,838.75 1 G		1.54
Farm Tractor	Reclamation	1	2,413 Km	.255 Kg/Km	567.75 1 G		567.75 1 G		.62
	Plowing & Seeding		80.94 ha	1.21 T/ha					97.94
Dump Truck, 10 yd ³	Road Work & Waste Hauling	4	38,963 Km	.255 Kg/Km	12,626 1 G		13,626 1 G		7.39
			74,572 T	.021 Kg/T					1.57
3/4 T. Trucks & Sedan	Light Duty Transportation	19	12,872 Km	.255 Kg/Km	3,028 1 G		57,532 1 G		3.28
Ambulance	Medical	1	400 Km	.255 Kg/Km	94.25 1 G		94.25 1 G		.10
Mobile Crane, 100 T	Backup Equipment	1	2,413 Km	.255 Kg/Km	946.25 1 D		946.25 1 D		.62
Tractor Truck	Backup Equipment	1	2,413 Km	1 Kg/Km	946.25 1 D		946.25 1 D		2.41
Forklift w/Trailer	Backup Equipment	1	2,413 Km	.255 Kg/Km	946.25 1 D		946.25 1 D		.62
Trail Cable Truck	Backup Equipment	1	2,413 Km	.255 Kg/Km	946.25 1 D		946.25 1 D		.62
Portable Water Pump	Waste Water Management	4	1,000 hr	-----	26,495 1 D		105,980 1 D		
Portable Electric Gen.	Power	2	3,000 hr	-----	11,355 1 G		22,710 1 G		
Portable Arc Welders	Equipment Maintenance	2	3,000 hr	-----	32,172.5 1 G		64,345 1 G		
Ammonium Nitrate	275 Charges, Explosives		2,903.04 T	90.7 Kg/Charge**			Total		24.94
			9.072 X 10 ⁶ T (3)	2 Kg/T (3)					
Coal Crush-Convey Load	Sizing & Train Loading		498.96 T	90.7 Kg/Charge			D-8, 374,149 1		18,144.0
Water Gel	Explosive		80.94 ha	1.21 T/ha**			G- 201,645		97.94
Wind	Soil Transport						8,575,794 1		19,267.88 Tons

* Data Supplied by Northern Energy Resources Company

** PEDCO Environmental, For E.P.A., March, 1977

*** Final E.I.S. Eastern Powder River Coal Basin of Wyoming, Oct. 74

(1) Best estimate derivial from literature

(2) Northwest Colorado Coal Final E.I.S., U.S. Dept. of Interior, Appendix D

(3) Compilation of Air Pollution Emission Factors, 2nd Edition, U.S. E.P.A. Triangle Park N.D., AP-42, page 8.20-1, 1975

The following section was prepared by Dr. Dale Bergren, now working at the Cardiovascular Research Institute in San Francisco, California.

POTENTIAL HUMAN HEALTH EFFECTS FROM EXPOSURE TO HIGH CONCENTRATIONS OF ATMOSPHERIC PARTICULATES

Concurrent with mining operations is the generation of fugitive dust. Certainly many variables exist which influence the production of air-borne dust which is then subject to inhalation by humans and animals. Among those variables are the types of mining operations, be it surface or underground, the moisture content of the soil, as well as the processes of loading, unloading, and transportation.

The inhalation of sufficient amounts of any dust over a prolonged period of time will produce some type of disease, either irritative or chemical.¹ However, dust containing silicates has been well documented as contributing to the development of respiratory diseases.

Exposure to dust during the mining of coal may lead to one of three pulmonary disorders: coal workers' pneumoconiosis, silicosis, and industrial bronchitis. The conditions of pneumoconiosis and silicosis and also silicosis and bronchitis are known to co-exist.²

Of the three respiratory disorders, silicosis is the most common and the most serious. Silicosis is caused by the inhalation of air-borne silicates having diameters ranging from 0.5 to 5.0 microns. Above 5 microns, dust particles are trapped along the upper respiratory tract, such as the nose, pharynx, and the upper bronchial tree. These particles are trapped by mucous lining the surface, and then are easily removed from the respiratory system by the ciliated cells which line this surface. Dust particles below 0.5 micron remain suspended throughout the respiratory cycle and therefore are exhaled. These smaller particles, hence, do not influence the function of the lungs. Particles having diameters between 0.5 and 5.0 microns do have the potential to reach the areas of the lung where gas exchange occurs--the respiratory ducts, the antrum, and the alveolus. At this point, sedimentation can occur on the fluid lining.

Table 1*

Particle size (microns)---	10	5	3.5	2.5	2
Respirable percentage-----	0	25	50	75	100

* Taken from Industrial Environmental Health, Cralley, L. V., et al., p. 318, Academic Press, New York, 1972.

¹Wolf, F. A., Occupational diseases of the lung, Part II, Inhalation diseases due to inorganic dust, Ann. Allergy 35; p. 87-92, 1975.

²Morgan, W. K. C., and Lapp, N. L., Respiratory diseases of coal miners, Am. Rev. Res. Dis. 113, p. 531-537, 1976.

The dust inhaled with ability to become deposited upon the alveolar surface has therefore been termed "respirable dust." In other words, it is the dust that reaches the alveolus and is capable of causing lung pathology or a condition of "pneumoconiosis." Pneumoconiosis is a Greek derivation and means "lung dust." It is a general term which refers to the deposition and retention of air-borne dust particles in the lung without regard to specific lung pathology. Various types of pneumoconiosis are recognized.

Silicosis pneumoconiosis or simply silicosis develops through the inhalation of crystalline free-silica dust. Since 10 percent of the earth's surface is composed of quartz,¹ free silica is thereby an important constituent in all mining operations.

Inhaled silica becomes deposited on the alveolar surface where it is phagotized by alveolar macrophages. The alveolar macrophage serves as the cleansing system of the lung's interior. There are conflicting reports on the next step in silicate toxicity.

One explanation states that silica is highly toxic to the roving macrophage cells. These cells die enroute to the lymph nodes. The dead cells become aggregated, then finally are enveloped by fibrotic tissue.² A second proposal states that during breakdown of the crystalline silica by the body or by its dissolving, an acid is produced. This acid destroys the cells of the lung which try to entrap the particle. As a result, a scar is formed which makes the lung stiff so that it becomes more and more difficult to move air in and out.³ A third possibility is that inhaled silica kills and lyses the macrophages to release an enzyme. This enzyme then stimulates fibroblast to produce collagen fibers. The result is a lesion of dead macrophages, dust, and fibrous matter.⁴

Following the primary lesion the fibrotic tissue proliferates into the characteristic silicotic nodule. These nodules are small at first but then coalesce with continued inhalation of silica dust. The lungs gradually become filled with many of these nodules. Years after the initial stages, but with continued growth of the nodules, normal lung function becomes hindered. The result is a condition of acute obstructive emphysema with a predisposition to tubercular infection.

Even at simple discrete nodules of hyaline fibrous tissue, no recognizable clinical manifestations exist.⁵ This may continue for years.

¹Mayer, M. R., Occupational health, The Williams and Wilkins Co., Baltimore, p. 41, 1969.

²Ibid., p. 254.

³Elmes, P. C., Occupational disease in road and building industry, Respiratory Disease, Chemistry and Industry #21, p. 1022-1026, 1973.

⁴Morgan, W. K. C., and Lapp, N. L., Respiratory diseases of coal miners, Am. Rev. Res. Dis. 113, p. 531-537, 1976.

⁵Wolf, F. A., Occupational diseases of the lung, Part II, Inhalation

The first sign of silicosis is dyspnea, but only upon exertion. The disease may progress to distort and destroy the pulmonary structure. This structure change produces an increased circulatory resistance and may therefore cause cardiac failure.

The highest generation of silica occurs where narrow bands of strippable coal exists because more silica-containing earth is likely to be disturbed.¹ Silicate dust may also be generated by such mining operations as blasting, transportation on unpaved roads, as well as overburden loading and unloading.

The silicosis hazard may be calculated as follows: ²

$$\text{Respirable dust (mg/m}^3\text{)} = \frac{10}{10 (\% \text{RFS} * + 2)} .$$

*Percent RFS = percent of free silica in dust.
The upper limit of respirable dust has been set at 2.0 mg/m³. ³

The dangers of silicosis increase when the dust is just freshly generated and especially when the particle size is extremely small. This is true in the cases of dust generated through the mining processes of blasting and drilling. Other factors which influence the danger of silicosis are the combination with other particulates, duration of contact, worker's age and past history of respiratory function. Special attention must be noted that smoking has been shown to increase the rate of silicosis in miners 30 times.⁴

COAL MINERS' PNEUMOCONIOSIS

Coal miners' pneumoconiosis, also called anthracosis, anthracosilicosis, or best known as black lung, is the result of inhaled coal dust high in carbon.⁵ Silica is unimportant in the development of miners' pneumoconiosis. The dust becomes deposited around the bronchioles and arterioles of the respiratory surface. This deposition causes the development of a type of emphysema called "focal emphysema." This is a major disability attributed to black lung disease. Usually there is not much fibrotic tissue formation. Massive fibrosis may form due to a secondary infection of tuberculosis. If fibrosis occurs, symptoms are apt to progress despite changes in environment.

¹Morgan, W. K. C., and Lapp, N. L., Respiratory diseases of coal miners, Am. Rev. Res. Dis. 113, p. 531-537, 1976.

²Cralley, L. V., Cralley, L. J., Clayton, G. D., and Jurgiel, J. A., Industrial environmental health, the workers, and the community, Academic Press, New York and London, p. 320, 1972.

³Ibid., p. 396,

⁴Ibid., p. 43.

⁵Wolf, F. A., Occupational diseases of the lung, Part II, Inhalation diseases due to inorganic dust, Ann. Allergy 35, p. 87-92, 1975.

INDUSTRIAL BRONCHITIS

The third pulmonary disorder that earlier was mentioned was industrial bronchitis. This disease is characterized by increased cough, sputum and a decrease in the ventilatory capacity. Industrial bronchitis develops through inhalation of dusts over long periods of time.¹ The affected area is the upper respiratory tract where dust irritation causes mucous production and inflammation.

MINING OPERATIONS AND THE SURROUNDING COMMUNITY

The effect of mining upon respiratory function is not always limited to the employed population, but has been shown to be reflected in the general population.

In a study of a metal mining community (where open-pit mining is the prevalent form) and a smelting community, it was observed that the incidence of lung carcinoma not only was elevated in the mining and smelting workers, but also among women who did not experience occupational exposure, when compared to the rates in other cities.²

Although the toxic substance was not identified, the best explanation for this situation seems to be that the same agent which increased cancer among the men from occupational exposure also increased the cancer among the women. In the smelting city, air-borne arsenic, sulfur dioxide, and possibly nitrogen dioxide may be indicated as the causal factors.

In a separate study, several communities where underground coal mines are a prominent industry provided statistics showing silicosis and black lung were clearly occupationally related.³ Unexpectedly, however, the wives of miners reported more respiratory disorders than the wives of other workers. It stated, "If occupational factors are involved in any way in the reported cough, phlegm, wheezing, and breathlessness, coal miners' wives seem to be nearly as affected by their husbands' occupations as husbands themselves." A possible explanation offered by the author is that chronic bronchitis contracted by the miners as the result of exposure to coal dust may have an infectious aspect in the bacteriological sense.

¹Morgan, W. K. C., and Lapp, N. L., Respiratory diseases of coal miners,

²Newman, J. A., Archer, V. E., Saccomanno, G., et al., Histologic types of bronchogenic carcinoma among members of copper-mining and smelting communities, Ann. N.Y., Acad. Sci. 271, p. 260-268, 1976.

³Enterline, P., The effect of occupation on chronic respiratory disease, Arch. Environmental Health 14, p. 189, 1967.

APPENDIX D-5.--Potential particulate emissions from the Spring Creek mine during the year 1985 at 7×10^6 tons of coal production

Operation	Emission factor/ unit/year ¹	Total units	Potential emissions (tons/yr)
<u>Overburden excavation</u>			
Scraper-----	16 lb/hr	4,000 hours	32.0
52 yd ³ dragline-----	0.05 lb/ton	8,573,000 tons	214.3
9-15 ³ overburden shovel---	0.05 lb/ton	2,336,000 tons	58.4
Overburden drill-----	0.22 lb/hole	12,000 holes	1.3
Front end loader-----	0.05 lb/ton	500,000 tons	12.5
D-9 cat dozer-----	32 lb/hr	12,000 hours	192.0
Overburden blasting-----	14.2 lb/blast	150 blasts	1.1
Subtotal-----			511.6
<u>Coal extraction</u>			
D-9 cat dozer-----	32 lb/hour	6,000 hours	96.0
Coal drill-----	2.25 lb/hole	12,000 holes	13.5
Coal shovel-----	0.12 lb/ton	7,000,000 tons	420.0
Coal blasting-----	25.1 lb/blast	150 blasts	1.9
Subtotal-----			531.4
<u>Hauling materials</u>			
Coal haulers-----	806.3 lb/VMT	322,200 miles	129,894.9
Overburden haulers-----	806.3 lb/VMT	240,000 miles	96,756.0
Grader-----	32.0 lb/hour	2,000 hours	32.0
Explosives trucks-----	97.6 lb/VMT	40,000 miles	1,952.0
Fuel truck-----	97.6 lb/VMT	3,750 miles	183.0
Welding truck-----	97.6 lb/VMT	3,750 miles	183.0
Lube truck-----	97.6 lb/VMT	3,750 miles	183.0
Hydraulic boom truck-----	97.6 lb/VMT	3,750 miles	183.0
Supplies truck-----	97.6 lb/VMT	7,500 miles	366.0
Maintenance truck-----	97.6 lb/VMT	11,250 miles	549.0
10 yd dump truck-----	97.6 lb/VMT	18,000 miles	878.4
Pickup trucks-----	8.6 lb/VMT	48,000 miles	206.4
Subtotal-----			231,366.7
<u>Coal handling</u>			
Coal hauler dumptruck----	0.83 lb/ton	7,000,000 tons	2,905.0
Crushing and screening---	0.18 lb/ton	7,000,000 tons	630.0
Coal storage-----	2.18 lb/ton	7,000,000 tons	7,630.0
Subtotal-----			11,165.0

APPENDIX D-5.--Potential particulate emissions from the Spring Creek mine during the year 1985 at 7×10^6 tons of coal production (cont.)

Operation	Emission factor/ unit/year ¹	Total units	Potential emissions (tons/yr)
<u>Reclamation</u>			
Scraper-----	16 lb/hour	4,000 hours	32.0
D-9 cat dozer-----	32 lb/hour	6,000 hours	96.0
Grader-----	32 lb/hour	2,000 hours	32.0
Farm tractors-----	167.5 lb/acre ²	219 acres	18.3
Subtotal-----			178.3
Wind erosion	1.2 tons/acre	1,038 acres	1,245.6
Subtotal-----			1,245.6
Total-----			244,998.6

¹All emission factors are taken from the list generated by the EPA, effective January 1, 1979.

²Emission factor from: Cowherd Jr., Chatten, J.H. Southerland and C. O. Mann, Development of emission factors for fugitive dust sources: MRI and EPA, p. 27.

APPENDIX D-6.--Regional coal dust emissions off unit trains

It has been empirically shown that coal dust losses from unit trains may range from a minimum of 0.0002 percent (Paulson and others, 1976) to a maximum of 0.42 percent (Nimerick and Laflin, 1977). Most of the loss has been observed to occur during the first fifty miles of transit (Paulson and others, 1976). The loss is dependent on train and wind speed (Nimerick and Laflin, 1977), season of the year (Guarnaschelli, 1977), degree of pulverization of the coal (Nimerick and Laflin, 1977; Paulson and others, 1976), and moisture content of the coal (Nimerick and Laflin, 1977).

Maximum coal train speeds in the Northern Powder River Basin are 40 miles per hour although the track from Colstrip to Nichols is restricted to 25 miles per hour, (Davies, 1978). Assuming no additional loss from wind, a maximum of approximately 0.40 percent of transported coal could be lost within the first fifty miles of transit, at 40 mi/hr train speeds. Since this estimate is based upon eastern coal (surface moisture content 9 percent) it will be used as a maximum indicator of coal dust loss. The minimum will be reported as 0.0002 percent.

High volume air sampling has shown that train traffic may increase total suspended particulate concentration by a range of 24 to 55 ug/m^3 in the immediate vicinity (Nalco Environmental Sciences, 1977). Coal train traffic was 14 percent of all traffic and represented less than 1 percent of the observed increase in particulate concentrations. The authors hypothesize that the observed increase in total suspended particulate is largely due to reentrainment of dust off the railroad tracks.

Annual dustfall can be computed from the calculated coal dust emissions as tons/mi^2 along the railway corridor/year. For example:

1985 coal dust lost: from Colstrip to 19 miles east of Forsyth,
a total of 50 miles.

$(18.5 \times 10^6 \text{ tons of coal/yr})(.004)(1/50 \text{ mi}^2)$

1,480 $\text{tons}/\text{mi}^2/\text{yr}$ *, maximum estimate

*Assumes most of the coal dust settles out within 1/2 mile of either side of the railway corridor.

APPENDIX D-7.--Gaseous emissions factors

Activity	Gas	Emission factors	Source
Blasting	NO _x (NO, NO ₂ , NO _x)	35.8 lb/ton Prilled ANFO	Chaiken et al., 1974 experimental
	CO	42.6 lb/ton Prilled ANFO	Theoretical
	HCN	0.108 lb/ton Prilled ANFO	Theoretical
Population	Particulate	0.06 tons/year/person	U.S. EPA 1973
	SO ₂	0.07	
	CO	0.84	Air Quality Control Region 143 (Montana)
	NO _x	0.17	
	Hydrocarbons (HC)	0.13	
Population	Particulate	0.30 tons/year/person	
	SO ₂	0.44	Air Quality Control Region 241 (Wyoming)
	CO	1.42	
	HC	.25	
	NO _x	.33	
Locomotive diesel	Particulate	1.07 lb/mile	URS 1976
	SO _x	2.45	
	CO	5.60	
	HC	4.04	
	NO _x	15.90	
	Organic acid	0.30	
	Aldehydes	0.24	
Heavy duty diesel- powered scrapers	Particulate	27.3 lb/10 ³ gal	U.S. EPA 1976 Table 3.2.7-1
	SO _x	31.2	
	CO	98.3	
	NO _x	419.0	
	Aldehydes	9.69	
	HC	42.2	
Heavy duty gasoline- powered trucks	SO _x	0.0008 lb/mile	U.S. EPA 1976
	CO	0.38	
	HC	0.03	
	NO _x	0.028	
	Particulate	0.003	
Light duty gasoline- powered trucks		1978 emissions	
	SO _x	0.0003 lb/mile	U.S. EPA 1976
	CO	0.059	
	HC	0.006	
	NO _x	0.010	
	Particulate	0.0012	
		1985 emissions	
	SO _x	0.0004 lb/mile	
	CO	0.021	
	HC	0.002	
	NO _x	0.003	
	Particulate	0.0005	

Appendix E-1. -- Subgroup classification of soil series recognized
in the Spring Creek permit area and the
dominant physiographic positions occupied

Soil Series	Subgroup and Family	Physiography and Parent Rocks
Colbar	Ustollic Camborthids: fine silty, mixed, mesic	Nearly level and gently sloping alluvial fans and terraces
Corkim	Ustollic Camborthids: fine loamy, mixed, mesic	Nearly level and gently sloping alluvial fans and terraces
Kimlen	Ustollic Camborthids: fine silty, mixed, mesic	Nearly level and gently sloping alluvial and colluvial fans and terraces, mod- erately deep to sedimentary bedrock.
Erlan	Aridic Haplustolls: coarse loamy, mixed, mesic	Fans and footslopes below ridges of scoria
Sperlin	Aridic Haplustolls: coarse loamy, mixed (calcareous), mesic	Moderately deep soils overlying scoria on the ridges and divides between stream valleys
Shinler	Ustic Torriorthents: fine silty, mixed (calcareous), mesic, shallow	Soils of the residual uplands shallow over sandstone, siltstone or shale
Travella	Lithic Ustic Torriorthents: loamy skeletal, mixed (calcareous), mesic	Shallow soils overlying hard sandstone occurring ridge crests and divides as well as on nearly level mesa tops
Wiberg	Ustic Torriorthents: frag- mental, mixed (calcareous), mesic	Shallow soils of the uplands overlying scoria
Alluvial	Ustic Torriorthents (field classification)	Alluvium in floodplains

Appendix E-2. -- Profile descriptions of soil series in the Spring Creek Area

COLBAR SERIES

This series consists of deep, well drained, silty soils on fans. Typically, these soils have a grayish brown, silty clay loam surface, light yellowish brown, prismatic calcareous, silty clay loam subsoils and light yellowish brown silty clay loam and silt loam substratum.

Representative profile of Colbar silty clay loam in Section 24, T8S, R39E, 550 feet south and 660 feet east of W1/4 corner:

- Ap--0 to 5 inches; grayish brown (2.5Y 5/2) dry, light silty clay loam, dark grayish brown (2.5Y 4/3) moist; strong very fine and fine granular structure; slightly hard when dry, very friable when moist, and slightly sticky but plastic when wet; weak effervescence.
- B21-5 to 9 inches; light yellowish brown (2.5Y 6/4) dry, light silty clay loam; light olive brown (2.5Y 5/4) moist; moderate medium prismatic structure separating to moderate fine and medium blocks; hard when dry, very friable when moist, slightly sticky but plastic when wet; weak effervescence.
- B22-9 to 15 inches; light yellowish brown (2.5Y 6/4) dry, light silty clay loam; light olive brown (2.5Y 5/4) moist; weak medium and coarse prismatic structure; hard when dry, very friable when moist, slightly sticky but plastic when wet; strong effervescence; few soft masses of segregated lime.
- Clca--20 to 31 inches; light yellowish brown (2.5Y 6/4) dry, heavy silt loam and light silty clay loam; light olive brown (2.5Y 5/4) moist; massive very hard when dry, very friable when moist, slightly sticky but plastic when wet; strong effervescence; few soft masses and threads of segregated lime.
- C2--31 to 40 inches; light yellowish brown (2.5Y 6/4) dry, heavy silt loam and light silty clay loam; light olive brown (2.5Y 5/4) moist, stratified; hard when dry, very friable when moist, slightly sticky but plastic when wet; strong effervescence.
- C3cs--40 to 78 inches; light yellowish brown (2.5Y 6/4) dry, light silty clay loam and heavy silt loam; light olive brown (2.5Y 5/4) moist; stratified; hard when dry, very friable when moist, slightly sticky but plastic when wet; strong effervescence; few threads and seams of segregated gypsum.
- C4--78 to 120 inches; light yellowish brown (2.5Y 6/3) dry, light silty clay loam and heavy silt loam; light olive brown (2.5Y 5/3) moist; stratified; hard when dry, very friable when moist, slightly sticky but plastic when wet; strong effervescence; few fine threads of visible silts below 96 inches.

Range in Characteristics: Depth to unweathered siltstone bedrock is $5\frac{1}{2}$ to over 12 feet. The texture of 10 to 40-inch control section is silty clay loam or heavy silt loam with 25 to 35 percent clay and less than 15 percent fine and coarser sands. The solum is 18 to 26 inches thick. Colors are in hue of 2.5 Y or 10 YR.

The A horizon has colors with value of 5 or 6 dry and 4 or 5 moist and chromas of 2 or 3. The B horizons have weak or moderate grade of structure and have color with value of 5 or 6 dry and chromas of 3 to 5. The C horizons have few or no segregations of lime. Depth to gypsum is 36 to 50 inches.

CORKIM SERIES

This series consists of deep, well drained, loamy soils on fans and terraces. Typically, these soils have brown loam A horizons, brown prismatic loam B horizons, and loam Cca and C horizons.

Representative profile of Corkim loam in Section 24, T8S, R39 E, about 700 feet west of center of Section:

Ap--0 to 6 inches; brown (10YR 5/3) dry, light loam; brown (10 YR 4/3) moist; weak very fine and fine granular structure; slightly hard when dry, very friable when moist, slightly sticky and slightly plastic when wet.

B2--6 to 16 inches; brown (10YR 5/3) dry, light loam; brown (10YR 4/3) moist; moderate medium prismatic structure separating to moderate fine and medium blocks; hard when dry, very friable when moist, slightly plastic when wet; strong effervescence; few soft masses of segregated lime.

C2--36 to 78 inches; light olive brown (2.5Y 5/3) dry; very fine sandy loam, loam, silt loam, and fine sandy loam stratified; light olive brown (2.5Y 4/3) moist; hard when dry, very friable when moist, slightly sticky and slightly plastic when wet; moderate effervescence. Texture of bulk is a light loam.

C3ca--78 to 96 inches; grayish brown (2.5Y 5/2) dry, very fine sandy loam, loam, silt loam, and fine sandy loam stratified; dark grayish brown (2.5Y 4/2) moist; moderate effervescence; few fine threads of segregated gypsum. Texture of bulk is a light loam.

C4--96 to 120 inches; grayish brown (2.5Y 5/2) dry, very fine sandy loam stratified with thin lenses of loam, silt loam, and fine sandy loam; dark grayish brown (2.5Y 4/2) moist; weak effervescence.

Range in Characteristics: Depth to bedrock is more than 8 feet. Texture of the 10- to 40-inch control section is loam or silt loam with less than 15 percent clay and more than 15 percent coarser than very fine sand. Colors are dominantly in the 2.5Y or 10YR hues, but include 7.5YR and 5YR hues in some profiles.

The A horizon has colors with value of 5 dry and 4 moist and chroma of 2 or 3. The B horizons have weak or moderate grades of structure. The segregated lime is absent in some pedons. Thickness of noncalcareous part of the soil is 4 to 16 inches. The lower C horizons below 7 feet contain varying amounts of rock fragments in some places.

ERLAN SERIES

This series consists of deep, well drained, red colored, loam soils formed in alluvium of fans and foot slopes. Typically, these soils have reddish brown loam A and B horizons and yellowish red slaty and channery loam C horizons.

Representative profile of Erlan slightly slaty loam in Section 31, T8S, R40E, about 1,575 feet west and 775 feet south of NE section corner:

A1--0 to 8 inches; reddish brown (5YR 5/3) dry, light loam; dark reddish brown (5YR 3/4) moist; weak fine and medium granular structure; soft when dry, very friable when moist, nonsticky and nonplastic when wet; about 10 percent by volume of very fine and fine flat porcelanite fragments.

B2--8 to 20 inches; reddish brown (5YR 5/3) dry, slaty light loam; dark reddish brown (5YR 3/4) moist; weak very fine and fine subangular blocky structure; soft when dry, very friable to loose when moist, nonsticky and nonplastic when wet; about 15 percent by volume of very fine and fine flat porcelanite fragments; weak effervescence in upper and moderate effervescence in low part.

C1--20 to 44 inches; yellowish red (5YR 5/6) dry, slaty light loam; yellowish red (5YR 4/6) moist; nonsticky and nonplastic when wet; about 25 to 30 percent by volume of porcelanite and fused sandstone fragments, mainly less than 1 inch in size but with a few up to 6 inches across; weak effervescence; lime crusts on undersides of larger fragments.

C3--60 to 84 inches; yellowish red (5YR 5/6) dry, slaty light loam; yellowish red (5YR 4/6) moist; massive; soft to loose when dry, very friable to loose when moist, nonsticky and nonplastic when wet; about 35 percent by volume of flat porcelanite and sandstone fragments, mainly less than 1 inch in size; weak effervescence.

C4--84 to 108 inches; yellowish red (5YR 5/6) dry, slaty and channery fine sandy loam; yellowish red (5YR 4/6) moist; massive; loose when dry and moist, nonsticky and nonplastic when wet; about 25 percent by volume of flat porcelanite and sandstone fragments; strong effervescence.

Range in Characteristics: Depth to bedrock is 6 feet to over 10 feet. Texture of the 10- to 40-inch control section is loam or very fine sandy loam with less than 5 percent clay and 15 to 35 percent by volume of rock fragments. Colors are in 5YR to 10R hue.

The A horizon has color with value of 5 dry and 3 or 4 moist and chroma of 3 or 4. The B horizon has a weak grade of structure and color with value of 5 dry and 3 or 4 moist and chroma of 3 to 5.

KIMLEN SERIES

This series consists of deep, well drained, silty soils formed in materials weathered in place from the underlying siltstone bedrock or in alluvium deposited on these geologic beds. Typically, these soils have grayish brown, silty clay loam A horizons; light olive brown silty clay loam B2 horizons, and light yellowish brown, calcareous, silt loam B3 and C horizons underlain by unweathered siltstone at about 48 inches.

Representative profile of Kimlen silty clay loam in Section 31, T8S, R40E, about 500 feet west of the center of the Section.

A1--0 to 4 inches; light brownish gray (2.5Y 5/3) dry, light silty clay loam; grayish brown (2.5Y 4/3) moist; moderate thin and moderately thick platy structure separating to moderate fine granules; hard when dry, very friable when moist, sticky and slightly plastic when wet.

B21--4 to 8 inches; light olive brown (2.5Y 5/4) dry, silty clay loam, olive brown (2.5Y 4/4) moist; moderate medium prismatic structure separating to moderate fine and medium blocks; hard when dry, very friable when moist, sticky and slightly plastic when wet.

B22--8 to 16 inches; light olive brown (1.5Y 5/4) dry, light silty clay loam, olive brown (2.5Y 4/4) moist; moderate medium prismatic structure separating to moderate fine and medium blocks; hard when dry, very friable when moist, sticky and slightly plastic when wet; weak effervescence.

B3ca--16 to 22 inches; light yellowish brown (2.5Y 6/4) dry, light silty clay loam, light olive brown (2.5Y 5/4) moist; weak medium and coarse prismatic structure separating to weak medium and coarse blocks; hard when dry, very friable when moist, sticky and slightly plastic when wet; strong effervescence; few soft masses of segregated lime.

Clca--22 to 34 inches; light yellowish brown (2.5Y 6/4) dry, heavy silt loam; light olive brown (2.5Y 5/4) moist; massive; hard when dry, very friable when moist, sticky and slightly plastic when wet; strong effervescence; common soft masses of segregated lime.

IIC2--34 to 46 inches; weathered siltstone bedrock.

IIC3r--46 to 60 inches; unweathered platy siltstone bedrock.

Range in Characteristics: Depth to the unweathered sedimentary bedrock is between 42 to 66 inches. The texture of the 10- to 40-inch control section is dominantly silty clay loam with 27 to 35 percent clay but includes heavy silt loam with more than 24 percent clay. Noncalcareous part of the profile is 0 to 8 inches thick. Colors are mainly in the 2.5Y hue.

The A horizon has value of 5 or 6 dry and 4 moist. The B2 horizons have weak or moderate grades of structure and have colors with value of 5 or 6 dry and 4 or 5 moist and chroma of 2 to 4. It has weak to strong effervescence. Few or no soft masses of segregated lime are present in the B3ca horizon.

SHINLER SERIES

This series consists of shallow loamy soils formed in residuum weathered from the underlying weakly or moderately consolidated loam-stones or siltstones of the Fort Union geological formation. Typically, these soils have grayish brown silt loam A horizons and pale olive silt loam C horizons underlain by platy siltstone within a depth of 20 inches.

Representative profile of Shinler silty clay loam in Section 27, T8S, R39E, 950 feet south and 1700 feet west of NE section corner, just above road:

Al--0 to 4 inches; grayish brown (2.5Y 5/2) dry, light silty clay loam, grayish brown (2.5Y 4/3) moist; weak very fine granular structure; soft when dry, very friable when moist, nonsticky and slightly plastic when wet; weak effervescence.

Cl--4 to 10 inches; pale olive (5Y 6/3) dry, light silty clay loam; olive (5Y 5/3) moist; weak coarse prismatic structure; hard when dry, very friable when moist, slightly sticky and slightly plastic when wet; strong effervescence.

C2--10 to 16 inches; variegated olive colored materials of light silty clay loam texture, about 50 percent by volume of mass consists of plates of siltstone that are hard and brittle when dry; strong effervescence. This is the weathered siltstone!

C3r--16 to 32 inches; platy siltstone that rubs to a silty clay loam texture; few roots between plates in upper few inches.

Range in Characteristics: Depth of soil over relatively unweathered sedimentary beds is 4 to 20 inches. Texture of the weathered regolith is loam, silt loam, or silty clay loam with 12 to 35 percent clay. Soft masses of segregated lime or of gypsum are present in some pedons. Colors are in hues of 5Y through 10YR.

SPERLIN SERIES

This series consists of moderately deep, red colored, loam soils formed in residuum weathered from the underlying moderately consolidated or indurated porcelanite or baked sandstone bedrock. Typically, these soils have reddish brown loam A horizons and red loam C and Cca horizons underlain by hard porcelanite or fused sandstone at about 26 inches.

Representative profile of Sperlin loam in Section 19, T8S, R40E, about 1000 feet north and 200 feet east of the center of the section.

A1--0 to 3 inches; reddish brown (2.5YR 5/3) dry, loam, reddish brown (2.5YR 4/4) moist; weak very fine and fine granular structure; soft when dry, very friable when moist, slightly sticky and nonplastic when wet; weak effervescence.

C1--3 to 12 inches; red (2.5YR 5/5) dry, loam; red (2.5YR 4/6) moist; weak coarse prismatic structure separating to weak fine and medium subangular blocks; slightly hard when dry, very friable when moist, slightly sticky and nonplastic when wet; moderate effervescence; few very fine and fine porcelanite fragments.

C2--12 to 20 inches; red (2.5YR 5/6) dry, loam, red (2.5YR 4/6) moist; weak medium and coarse blocky structure; slightly hard when dry, very friable when moist, slightly sticky and nonplastic when wet; moderate effervescence; few fine sandstone and porcelanite fragments.

C3ca--20 to 26 inches; light red (2.5YR 6/6) dry, loam; red (2.5YR 5/6) moist; massive; slightly hard when dry, very friable when moist; slightly sticky and nonplastic when wet; strongly effervescent; few sandstone and porcelanite fragments with lime on undersides.

R--26 to 36+ inches; fractured and shattered sandstone which is partially weathered in upper 6 inches.

Range in Characteristics: Depth to partially weathered porcelanite and/or sandstone is 20 to 30 inches; and to unweathered bedrock 24 to 40 inches. The texture of the control section (10 inches to bedrock) is very fine sandy loam, loam, or silt loam with less than 10 percent clay

and less than 15 percent by volume of rock fragments larger than 2mm in size. Colors are in hue of 5YR through 10R.

The A1 horizon has value of 5 dry and 3 or 4 moist and chroma of 3 or 4. The C horizon has value of 5 or 6 dry and 4 moist and chroma of 4 to 6.

The underlying bedrock consists mainly of shattered and fractured porcelanite and fused sandstone but may be buff colored, hard sandstone in some places. The upper 4 to 8 inches is partially weathered but contains less than 10 percent by volume of fines. Below this weathered upper part the unweathered bedrock may be fractured and shattered or unfractured but it forms a continuous phase at least 4 inches between vertical fractures.

TRAVELLA SERIES

This series consists of shallow and very shallow soils underlain by hard sandstone within 5 inches. Typically, these soils have grayish brown very channery loam A horizons and brown very channery loam C horizons underlain by hard sandstone within 10 inches.

Representative profile of Travella very channery loam in Section 22, T8S, R39E, about 1,000 feet north and 1,200 feet west of E $\frac{1}{4}$ corner:

A1--0 to 2 inches; grayish brown (10YR 4/3) dry, very channery light loam, brown (10YR 4/3) moist; weak fine and very fine granular structure; soft when dry, very friable when moist, nonsticky and non plastic when wet.

C--2 to 5 inches; brown (2.5Y 5/3) dry, very channery light loam, dark brown (10YR 4/3) moist; massive; soft when dry, very friable when moist, nonsticky and nonplastic when wet; about 50 percent by volume of sandstone fragments.

R--5+ inches; hard sandstone.

Range in Characteristics: Depth to hard sandstone is 2 to 10 inches. Texture of the regolith is loam or fine sandy loam with more than 50 percent by volume of rock fragments.

WIBERG SERIES

This series consists of shallow, red colored, loamy soils over shattered and fractured porcelanite and fused sandstone. Typically, these soils have weak red loam A horizons and red loam C horizons underlain by fractured scoria or fused sandstone within 10 inches.

Representative profile of Wiberg loam in Section 30, T8S, R40E, about 250 feet south and 200 feet west of E $\frac{1}{4}$ corner.

A1--0 to 2 inches; weak red (10R 5/4) dry, light loam; weak red (10YR 4/4) moist; weak very fine and fine granular structure; soft when dry, very friable when moist, slightly sticky and non plastic when wet; about 5 percent by volume of fine porcelanite fragments.

C1--2 to 10 inches; red (10R 5/6) dry, light loam; red (10R 4/6) moist; weak very fine to medium granular structure; soft when dry; very friable when moist, slightly sticky and slightly plastic when wet; moderate effervescence; few fine porcelanite fragments.

R1--10 to 19 inches; partially weathered, fractured and shattered porcelanite and fused sandstone with less than 5 percent by volume of fines mainly in fractures and between horizontal bedding planes; strong effervescence; lime crusts on both upper and lower surfaces of fragments.

R2--19 to 24+ inches; consolidated porcelanite and baked sandstone which is somewhat fractured and shattered.

Range in characteristics: Depth to fractured and shattered bedrock is 4 to 16 inches. Texture of the regolith is very fine sandy loam, loam, or silt loam with less than 5 percent clay and 5 to over 50 percent rock fragments. Colors are in hues of 5YR through 10R.

2 Alluvial lands, loamy

This unit is on the flood plains and low bottomlands within the narrow intermittent stream valleys. It is a miscellaneous land type consisting of several different kinds of soils of varying textures and ranging from less than 20 inches to over 84 inches to sand and gravel. Strata consisting of sand or sand and gravel occur at any depth, but usually below 24 inches, in many places. Some areas of clayey and sandy or gravelly soils occur in some places. Small areas less than one acre in size of wet or wet and saline soils are included.

The soils in this mapping unit have been dissected to varying degrees by stream channels. They may or may not be subject to overflow and depositions of fresh material during periods of high runoff.

In places, the vertical sidewalls flanking the stream valley are included within a delineation.

Areas up to two acres in size are without deep channels.

APPENDIX E-3
SOIL CHEMISTRY

Series	Depth (in.)	pH (paste)	E.C. (mmhos/cc)	Saturation %	Ca (meq/L extract)	Mg (meq/L extract)	Na (meq/L extract)	SAR	Boron (ppm)	Particle Size Distribution					Textural Class			
										%				SN		VFS	SI	CL
Kimlen	0-6	8.2	1.7	71.8	12.5	1.9	3.9	1.5	0.4	5	21	39	35	CLm-SiCLm				
	6-16	8.3	2.8	66.1	14.4	2.3	8.3	2.9	0.5	5	24	63	8	SiLm-Si				
	16-22	7.9	5.2	55.2	28.8	14.5	10.0	2.2	0.4	6	21	61	21	SiLm				
	22-34	7.9	5.3	52.8	26.5	19.3	11.3	2.4	0.4	5	26	55	14	SiLm				
	34-48	8.0	14.2	65.0	22.9	77.8	29.5	4.2	0.4	7	28	64	1	SiLm-Si				
	48-60+	6.9	19.4	74.3	19.0	143.6	18.6	2.1	0.4	26	16	37	21	Lm				
Shinler	0-5	8.9	2.2	71.5	7.0	2.7	9.9	4.5	0.3	4	12	56	28	SiCLm				
	5-10	9.2	3.5	85.2	7.0	3.0	21.8	9.7	0.1	4	12	54	30	SiCLm				
	10-15	9.2	4.1	79.4	8.2	3.4	33.7	14.0	0.4	4	11	54	31	SiCLm				
	15-30+	8.7	12.3	85.4	6.0	13.7	87.7	22.7	0.1	4	13	51	32	SiCLm				
Shinler	0-4	8.4	1.7	67.1	10.4	3.0	3.9	1.5	0.5	3	9	56	32	SiCLm				
	4-10	8.2	1.7	69.6	8.6	2.5	4.4	1.8	0.5	3	8	58	31	SiCLm				
	10-16	8.5	0.9	76.2	17.0	2.6	3.5	2.0	0.5	3	9	53	35	SiCLm				
	16-32	8.9	1.1	83.8	2.7	1.9	6.9	4.5	0.6	3	11	53	33	SiCLm				
Sperlin	0-3	8.1	2.3	53.3	13.1	1.9	6.2	2.3	0.3	31	20	38	11	Lm				
	3-20	8.2	2.3	58.0	9.5	2.6	7.6	3.1	0.3	31	22	37	10	FSLm-Lm				
	20-38	8.3	13.2	41.0	33.9	69.1	32.2	4.5	0.7	29	19	40	12	Lm				
Sperlin	0-3	7.7	1.5	70.2	7.8	1.8	5.6	2.5	0.4	39	18	37	6	FSL				
	3-20	8.2	3.1	71.8	21.5	3.2	6.8	1.9	0.4	38	17	40	5	FSLm				
	20-34	8.8	5.6	60.7	14.0	8.4	26.5	7.9	0.7	36	19	41	4	FSLm				
	34-40	8.8	4.9	63.3	15.0	10.4	28.0	7.9	0.7	35	18	42	5	FSLm				
Travella	0-5	8.3	2.3	72.9	10.3	1.7	6.7	2.7	0.4	5	30	35	20	Lm				
Travella	0-5	7.7	1.8	58.8	10.2	2.4	4.0	1.6	0.5	15	29	42	14	Lm				
Wiberg	0-6	7.5	2.4	60.4	14.1	3.9	4.9	1.6	0.3	32	18	40	10	Lm				
	6-24	8.3	2.3	59.2	13.5	4.9	5.2	1.7	0.6	32	19	42	7	Lm				
Wiberg	0-2	7.7	1.9	68.2	9.5	2.7	4.3	1.7	0.3	25	16	41	18	Lm				
	2-10	8.2	2.0	64.9	9.2	3.1	6.1	2.4	0.6	29	17	42	12	Lm				

APPENDIX E-3
SOIL CHEMISTRY

Corkim	0-6	7.6	2.1	68.7	11.6	6.8	5.2	1.7	0.3	3	9	50	38	SiClm
	6-16	8.1	1.2	74.7	5.4	3.3	3.0	1.4	0.3	21	27	36	16	Lm
	16-36	8.7	1.0	79.2	3.2	4.5	2.5	1.3	.05	11	19	36	34	CLm
	36-56	9.2	1.6	54.3	2.8	6.9	5.2	2.4	0.8	12	22	37	29	CLm
	56-78	8.5	9.3	51.4	32.8	55.1	9.2	1.4	0.3	14	31	37	18	Lm
	78-96	8.4	11.4	47.5	34.1	59.6	9.1	1.3	0.2	12	27	37	24	Lm
	96-120	8.3	9.5	49.8	28.4	46.9	12.3	2.0	0.1	14	29	37	20	Lm
	0-6	7.5	1.4	70.0	4.3	3.5	3.3	1.7	0.5	26	14	42	18	Lm
	6-12	8.2	1.2	73.1	5.5	3.0	3.6	1.8	0.4	28	13	43	16	Lm
	12-27	8.6	1.6	52.0	5.8	4.5	4.1	1.8	0.3	25	13	45	17	Lm
Erlan	27-46	8.9	1.7	49.0	4.1	8.5	3.8	1.5	0.4	28	12	45	15	Lm
	46-56	9.0	2.3	39.0	3.8	10.7	6.8	2.5	0.7	26	13	44	17	Lm
	56-73	8.8	2.3	40.7	6.1	13.5	5.2	1.7	0.6	37	39	16	8	VFSLm
	73-96	8.7	3.7	34.5	7.2	15.2	7.9	2.3	0.4	37	36	18	9	FSLm-VFSLm
	0-6	7.6	1.2	61.5	6.4	2.0	3.7	1.8	0.4	41	31	22	6	FSLm
	6-20	8.3	4.0	50.7	21.7	3.0	9.4	2.7	0.6	42	33	21	4	LFS-FSLm
	20-34	8.3	2.6	45.9	13.1	4.9	10.4	3.5	0.4	40	35	23	5	FSLm
	34-44	8.5	3.4	44.5	15.7	3.7	13.3	4.3	0.4	42	32	21	5	FSLm
	44-60	8.5	3.4	42.6	16.4	4.7	16.1	5.0	0.4	31	37	27	5	VFSLm
	60-84	8.5	3.1	45.2	17.7	3.9	12.9	3.9	0.5	32	39	25	4	VFSLm
Erlan	84-108	8.5	4.8	42.4	20.0	5.3	13.3	4.3	0.4	31	41	24	4	VFSLm
	0-6	7.7	2.0	67.3	7.4	4.2	3.9	1.6	0.1	32	17	43	8	Lm
	6-14	8.2	1.3	66.5	7.5	2.9	3.7	1.6	0.2	29	18	44	9	Lm
	14-28	8.4	2.1	54.5	11.9	5.2	5.7	2.0	0.4	30	17	46	7	Lm-FSLm
	28-43	8.6	1.8	54.7	7.3	5.3	6.7	2.6	0.7	31	19	44	6	FSLm
	43-58	8.7	2.7	49.0	8.2	6.3	9.7	3.6	0.9	23	14	46	17	Lm
	58-74	8.4	4.3	51.4	9.7	21.1	13.3	3.4	1.0	26	16	46	12	Lm
	74-96	8.3	7.2	54.5	22.9	33.6	17.2	3.2	0.8	32	17	41	10	Lm
	0-6	8.5	1.8	61.8	8.1	4.7	4.2	1.7	-0.1	9	27	40	24	Lm
	6-14	8.6	2.0	70.9	7.8	5.8	3.4	1.3	0.2	13	25	36	26	Lm
Kimlen	14-24	9.3	1.1	65.3	3.1	3.3	4.8	2.7	-0.1	7	27	38	28	CLm
	24-34	8.6	7.8	68.8	14.2	41.2	22.9	4.3	0.2	7	23	37	33	CLm
	34-50	8.4	17.4	68.5	22.3	113.1	41.2	5.0	-0.1	8	24	36	32	CLm
	50-58	8.2	19.0	76.7	22.0	108.6	48.0	5.9	-0.1	8	21	37	34	CLm
	58-72	8.1	12.7	76.0	18.8	78.9	45.7	6.5	-0.1	6	20	38	36	CLm
	0-6	8.5	1.8	61.8	8.1	4.7	4.2	1.7	-0.1	9	27	40	24	Lm
	6-14	8.6	2.0	70.9	7.8	5.8	3.4	1.3	0.2	13	25	36	26	Lm
	14-24	9.3	1.1	65.3	3.1	3.3	4.8	2.7	-0.1	7	27	38	28	CLm

Series	Depth (in.)	pH (paste)	E.C. (mmhos/cc)	Saturation %	Ca (meq/L extract)	Mg (meq/L extract)	Na (meq/L extract)	SAR	Boron (ppm)	Particle Size Distribution					Textural Class
										SN	VFS	SI	CL	%	
Colbar	0-6	8.1	3.3	66.6	16.5	7.5	12.3	3.5	0.4	13	28	47	12	Lm	
	6-11	8.7	2.3	68.7	10.9	6.4	3.8	1.3	0.5	3	17	52	28	SiCLm	
	11-21	8.7	4.1	67.5	20.9	11.6	7.0	1.7	0.5	3	15	50	32	SiCLm	
	21-34	8.5	14.0	56.2	29.0	83.9	17.8	2.4	0.5	8	24	43	25	Lm	
	34-54	8.6	16.2	69.3	22.4	114.5	29.2	3.5	0.5	10	24	39	27	CLm	
	54-78	8.7	14.7	70.4	23.9	90.6	47.5	6.3	0.5	11	26	37	26	Lm	
	78-100	8.8	13.5	69.7	15.1	60.4	46.5	7.6	0.3	7	25	38	30	CLm	
	100-120	9.0	7.5	77.6	14.8	33.3	24.5	5.0	0.6	11	25	36	28	CLm	
Colbar	0-6	8.6	2.3	63.7	10.2	4.2	8.0	3.0	0.6	10	28	35	27	CLm-Lm	
	6-18	9.1	5.6	69.6	20.8	22.7	7.6	1.6	0.3	12	21	38	29	CLm	
	18-32	9.1	4.1	69.6	5.7	15.6	17.4	5.3	0.4	5	16	46	33	SiCLm	
	32-50	8.5	10.9	71.9	21.3	46.4	42.2	7.2	-0.1	5	11	46	38	SiCLm	
	50-68	8.6	8.5	59.5	15.1	30.8	40.4	8.4	-0.1	5	13	46	36	SiCLm	
	68-84	8.7	9.1	73.0	12.3	25.1	42.9	9.9	0.1	2	2	48	48	SIC	
	0-6	8.2	2.6	68.5	9.5	7.2	9.1	3.2	-0.1	14	27	43	16	Lm	
	6-15	8.6	1.1	75.3	4.6	3.8	2.5	1.2	0.2	4	14	48	34	SiCLm	
Colbar	15-31	9.2	1.5	62.2	3.2	5.0	5.2	2.6	0.2	11	21	37	31	CLm	
	31-40	8.5	6.7	67.2	11.2	31.0	17.3	3.8	-0.1	11	22	35	32	CLm	
	40-52	8.6	6.0	61.4	7.3	28.5	23.0	5.4	-0.1	11	20	40	29	CLm	
	52-61	8.6	7.5	75.8	5.3	29.7	29.6	7.1	-0.1	4	14	46	36	SiCLm	
	61-78	8.7	7.1	75.8	5.3	33.0	26.8	6.1	-0.1	3	7	50	40	SiC-SiCLm	
	78-96	8.6	7.0	76.9	5.2	23.8	35.7	9.4	-0.1	11	20	41	28	CLm	
	96-120	8.8	8.1	65.6	9.1	35.6	24.9	5.3	0.2	11	22	40	47	CLm-Lm	
	0-6	8.1	3.5	62.5	22.4	9.7	6.3	1.6	0.4	22	15	34	29	CLm	
Colbar	6-16	8.5	1.7	69.4	10.1	4.7	4.6	1.7	0.4	23	15	35	27	CLm-Lm	
	16-32	9.1	1.2	71.7	2.5	2.3	8.3	5.3	0.5	10	19	35	36	CLm	
	32-50	8.8	7.4	60.0	13.3	37.2	27.7	5.5	0.6	11	21	35	33	CLm	
	50-70	8.6	12.6	56.0	28.6	71.1	26.1	3.7	0.4	12	23	35	30	CLm	
	70-84	8.5	14.0	64.2	24.1	59.7	40.2	6.2	0.3	14	23	36	27	CLm-Lm	
	84-100	8.6	15.0	59.8	24.5	69.7	41.1	6.0	0.3	16	26	35	23	Lm	

HERBS (cont.)

Microseris troximoides Gray
Microsteris gracilis (Hook.) Greene
 var. humilior (Hook.) Cronq.
Mirabilis linearis (Pursh) Helmerl
Monarda fistulosa L.
 var. menthaefolia (Grah.) Fern.
Monolepis nuttalliana (Schultes) Greene
Misineon divaricatum (Pursh) Nutt.
Navarretia intertexta (Benth.) Hook.
 var. propinqua (Suksd.) Brand
Oenothera caespitosa Nutt.
 var. montana (Nutt.) Durand
Oenothera serrulata Nutt.
Oenothera strigosa Mxze. & Bush
Opuntia polyacantha Haw.
Orbanche fasciculata Nutt.
Orthocarpus luteus Nutt.
Oxytropis besseyi (Rydb.) Blank.
 var. besseyi
Oxytropis lagopus Nutt. var. lagopus
Oxytropis sericea Nutt. var. sericea
Paronychia sessiliflora Nutt.
Penstemon albidus Nutt.
Penstemon eriantherus Pursh
 var. eriantherus
Penstemon nitidus Dougl. var. nitidus
Petalostemon candidum Michx.
Petalostemon purpureum (Vent.) Rydb.
 *Petasites sagittatus (Banks) Gray

False-agoseris	Big sage/mixed grass	Big sage/needle&thread	Big sage/bluebunch	Silver sage	Bipartian	Skunkbush	Shadscale	Mixed grass	Western	Needle & thread	Blue grama	Clant wildrye	Weed
Pink microsteris	x	x	x	x				x	x	x	x	x	x
Narrow-leaved four-o'clock	x								x				
Wild bergamot													
Patata								x					
Leafy musineon	x	x										x	x
Needle-leaf navarretia													
Rock rose													x
Shrubby evening-primrose													
Common evening-primrose													
Starvation cactus	x	x	x		x		x	x	x	x	x	x	x
Clustered broomrape													x
Yellow owl-clover	x												
Bessey's crazyweed	x												x
Rabbit-foot crazyweed											x		x
Silky crazyweed		x					x						x
Whitlow herb	x												x
White-flowered penstemon	x	x	x		x	x	x	x	x	x	x	x	x
Fuzzytongue penstemon	x	x											x
Shining penstemon	x	x			x							x	x
White prairie-clover	x	x											x
Purple prairie-clover	x	x		x	x	x	x	x	x	x	x		x
Arrowleaf coltsfoot													x

*Identification tentative - plants not in flowering condition during sampling period.

PERENNIAL GRASSES AND SEDGES (cont.)

Calamovilfa longifolia (Hook.) Scribn.
Carex filifolia Nutt.
Carex praegracilis W. Boott
Distichlis stricta (Torr.) Rydb.
 var. stricta
Echinochloa crusgalli (L.) Beauv.
Eleocharis palustris (L.) R. & S.
Elymus ambiguus Vasey & Scribn. var. ambiguus
 Elymus canadensis L.
Elymus cinereus Scribn. & Merr. var. cinereus
Festuca idahoensis Elmer var. idahoensis
Hordeum jubatum L.
Hordeum persicillum Nutt.
Koeleria cristata Pers.
Muhlenbergia cuspidata (Torr.) Rydb.
Orzopsis hymenoides (R. & S.) Ricker
Phleum pratense L.
Poa juncifolia Scribn.
Poa pratensis L.
Poa sandbergii Vasey
Poa scabrella (Thurb.) Benth.
Schedonnardus paniculatus (Nutt.) Trel.
Scirpus americanus Pers.
Sitanion hystrix (Nutt.) Smith
 var. brevifolium (Smith) Hitchc.
Sporobolus cryptandrus (Torr.) Gray
Stipa comata Trin. & Rupr. var. comata
Stipa occidentalis Thurb.
Stipa minor (Vasey) Hitchc.

	Big sage/mixed grass	Big sage/needle&thread	Big sage/bluebunch	Silver sage	Riparian	Skunkbush	Shadscale	Mixed grass	Western	Needle & thread	Blue grama	Giant wildrye	Weed	GPH
Prairie sandgrass								x		x			x	
Thread-leaved sedge	x	x	x					x		x	x		x	
Clustered field sedge													x	
Alkali saltgrass								x						x
Large barnyard-grass														
Common spike-rush													x	
Colorado wildrye													x	
Canada wildrye														
Giant wildrye				x	x							x		
Blue Bunchgrass														
Squirrel-tail barley										x	x		x	
Little barley													x	
Prairie junegrass	x	x	x	x				x	x				x	
Prairie rush-grass													x	
Indiana ricegrass						x							x	
Common timothy													x	
Alkali bluegrass	x												x	
Kentucky bluegrass				x							x	x	x	
Sandberg's bluegrass	x	x	x	x	x	x	x	x	x	x	x		x	
Pine bluegrass	x	x	x	x		x	x	x	x				x	
Tumblegrass								x					x	
American bulrush													x	
Bottlebrush squirreltail							x							
Sand dropseed	x	x		x				x	x	x	x		x	
Needle-and-thread	x	x	x	x	x	x	x	x	x	x	x		x	
Western needlegrass	x	x	x	x				x	x	x	x		x	

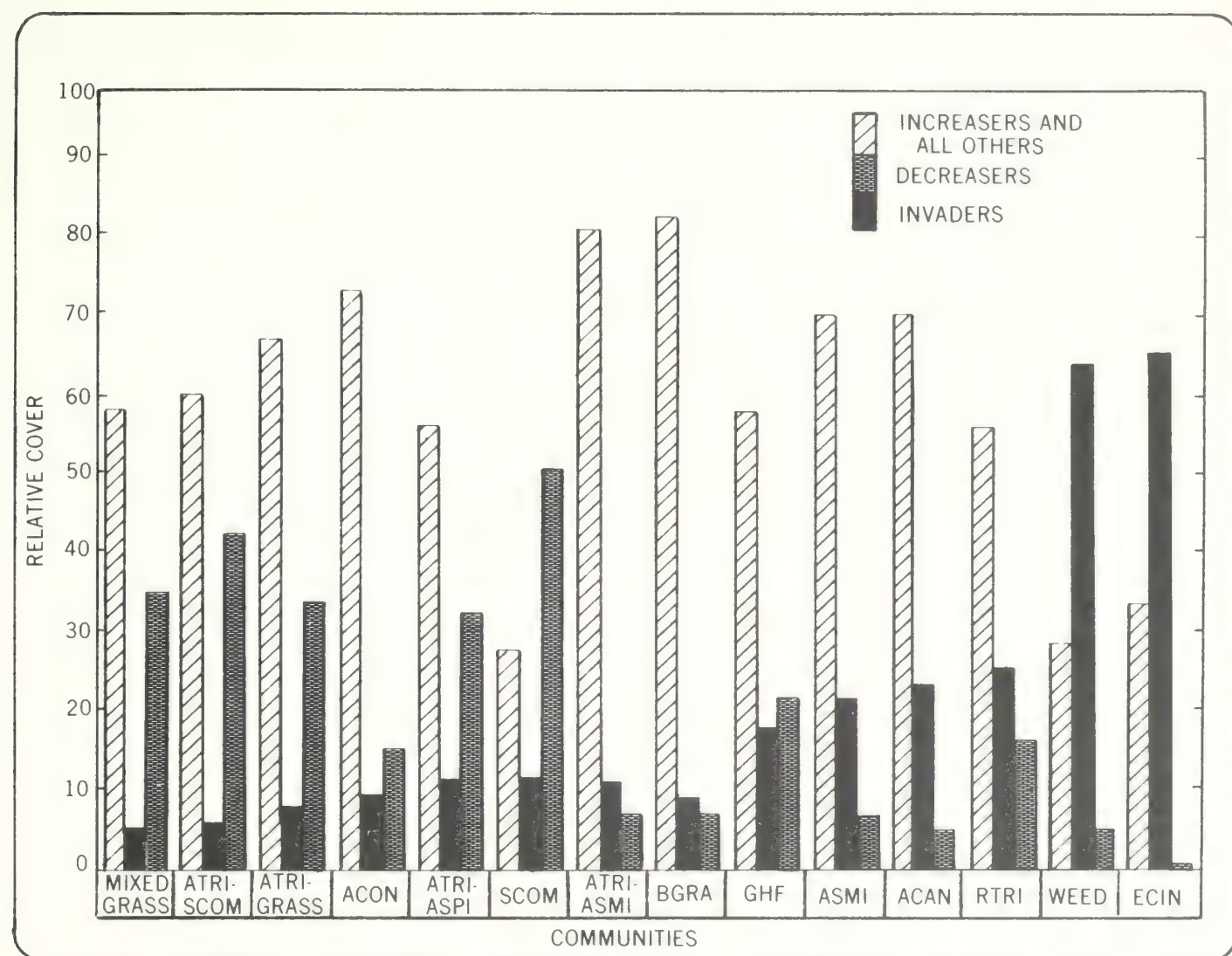
Appendix F-2. -- Annual Biomass Increment by Community and Functional Group

<u>Community</u>	<u>Functional Group</u>	<u>\bar{X} (g)</u>	<u>Range</u>	<u>N</u>
Blue Grama				
BGRA (5)**	AG	0.38	0.1 - 0.8	5
"	PG	37.08	29.6 - 46.8	5
"	F	0.22	0.1 - 0.6	5
"	HS	1.98	0.0 - 9.9	1
"	O	0.02	0.0 - 0.1	1
WEED (43)**				
"	AG	17.60	0.0 - 68.9	31
"	PG	75.50	0.0 - 287.6	43
"	L	13.02	0.0 - 256.1	26
"	F	22.95	0.0 - 293.6	40
"	HS	4.25	0.0 - 57.1	10
"	Co	0.02	0.0 - 0.9	1
"	C	0.20	0.0 - 9.1	1
"	CES	14.30	0.0 - 173.7	5
Grass/half-shrub/forb				
GHF (75)**	AG	0.03	0.0 - 0.7	13
"	PG	20.24	5.1 - 75.5	75
"	L	2.16	0.0 - 11.4	59
"	F	11.57	0.0 - 61.8	74
"	HS	11.51	0.0 - 66.6	66
"	O	1.53	0.0 - 104.8	6
"	C	1.72	0.0 - 15.9	25
"	Y	1.55	0.0 - 65.6	5
"	PP	0.31	0.0 - 2.3	1
MIXED GRASS (35)**				
"	AG	6.01	0.0 - 34.6	34
"	PG	53.19	0.0 - 84.0	34
"	L	1.00	0.0 - 7.7	18
"	F	3.90	0.1 - 16.3	35
"	HS	2.61	0.0 - 27.7	12
"	C	0.61	0.0 - 15.6	3
"	O	4.45	0.0 - 44.1	5
Big sagebrush/mixed grass				
ATRI-GRASS (35)**	AG	2.84	0.0 - 22.6	30
"	PG	27.87	6.7 - 55.3	35
"	L	0.42	0.0 - 3.4	11
"	F	3.34	0.0 - 15.6	33
"	HS	2.19	0.0 - 12.7	18
"	O	12.64	0.0 - 165.9	9
Skunkbush				
RTRI (5)**	AG	5.18	1.4 - 7.7	5
"	PG	31.72	5.8 - 75.8	5
"	L	0.64	0.0 - 1.9	4
"	F	8.86	5.7 - 11.6	5
"	HS	6.06	0.2 - 27.8	5

<u>Community</u>	<u>Functional Group</u>	<u>\bar{X} (g)</u>	<u>Range</u>	<u>N</u>
Western wheatgrass				
ASMI (20)**	AG	6.39	0.1 - 32.7	20
"	PG	51.01	17.1 - 108.7	20
"	L	0.07	0.0 - 0.6	5
"	F	0.88	0.0 - 3.1	17
"	O	0.58	0.0 - 41.1	3
Big sagebrush/blue bunch wheatgrass				
ATRI-ASPI (30)**	AG	1.18	0.0 - 20.6	24
"	PG	31.72	8.1 - 100.8	30
"	L	1.16	0.0 - 12.5	20
"	F	6.48	0.0 - 39.6	26
"	HS	2.23	0.0 - 12.6	16
"	O	6.23	0.0 - 141.3	3
Big sagebrush/western wheatgrass				
ATRI-ASMI (10)**	AG	1.18	0.0 - 4.1	8
"	PG	24.30	8.3 - 47.4	10
"	F	5.89	0.1 - 30.6	10
"	HS	0.89	0.4 - 3.0	5
"	O	9.18	0.0 - 72.6	4
Needle-and-thread				
SCOM (5)**	AG	15.90	3.9 - 36.8	5
"	PG	37.40	26.8 - 51.6	5
"	L	0.10	0.0 - 0.5	1
"	F	0.60	0.2 - 0.9	5
"	O	35.22	0.0 - 138.9	2
"	C	0.42	0.0 - 2.1	1
Big sagebrush/needle-and-thread				
ATRI-SCOM (15)**	AG	1.39	0.0 - 10.6	12
"	PG	21.85	8.1 - 32.1	15
"	L	0.85	0.0 - 3.5	9
"	F	6.71	0.1 - 36.1	15
"	H	7.45	0.0 - 32.5	10
"	C	0.08	0.0 - 0.9	2
"	O	4.37	0.0 - 63.4	2
"	Y	0.28	0.0 - 2.7	2
Silver sagebrush				
ACAN (5)**	AG	3.06	1.0 - 5.3	5
"	PG	105.34	45.7 - 191.8	5
"	L	17.50	0.0 - 69.0	3
"	F	0.38	0.0 - 1.1	3
"	HS	0.06	0.0 - 0.3	1

KEY to Functional Groups

O	= <u>Opuntia polyacantha</u>
Co	= <u>Coryphantha missouriensis</u>
C	= <u>Carex filifolia</u>
CES	= <u>Carex spp.</u> and <u>Eleocharis palustris</u> and <u>Scirpus americanus</u>
AG	= Annual grasses
PG	= Perennial grasses
L	= Legumes
F	= Forbs
HS	= Half-shrubs
Y	= <u>Yucca glauca</u>
PP	= <u>Pinus ponderosa</u> seedling
*	= sample of 3m ²
N	= Number of occurrences
S.D.	= Standard Deviation
$\bar{X}(g)$	= Mean weight/m ² in grams
**	= Total number of 1m ² samples



RANGE CONDITION BY COMMUNITY

Appendix G-1

MAMMAL SPECIES LIST¹

Insectivora

*	Masked shrew	<u>Sorex cinereus</u>
*	Merriam's shrew	<u>Sorex merriami</u>
*	Vagrant shrew	<u>Sorex vagrans</u>

Chiroptera

*	Keen's myotis	<u>Myotis keenii</u>
	Little brown myotis	<u>Myotis lucifugus</u>
	Long-eared myotis	<u>Myotis evotis</u>
	Marked or Least myotis	<u>Myotis leibii</u>
	Long-legged myotis	<u>Myotis volans</u>
	Small-footed myotis	<u>Myotis subulatus</u>
*	Silver-haired bat	<u>Lasionycteris noctivagans</u>
*	Big brown bat	<u>Eptesicus fuscus</u>
*	Hoary bat	<u>Lasiurus cinereus</u>
*	Spotted bat	<u>Euderma maculatum</u>
	Western big-eared bat	<u>Plecotus townsendii</u>

Carnivora

	Long-tailed weasel	<u>Mustela frenata</u>
*	Badger	<u>Taxidea taxus</u>
	Striped skunk	<u>Mephitis mephitis</u>
	Coyote	<u>Canis latrans</u>
	Red fox	<u>Vulpes vulpes</u>
	Bobcat	<u>Lynx rufus</u>

Rodentia

	Yellow-bellied marmot	<u>Marmota flaviventris</u>
	Black-tailed prairie dog	<u>Cynomys ludovicianus</u>
	Thirteen-lined ground squirrel	<u>Spermophilus tridecemlineatus</u>
	Least chipmunk	<u>Eutamias minimus</u>
*	Northern pocket gopher	<u>Thomomys talpoides</u>
	Olive-backed pocket mouse	<u>Perognathus fasciatus</u>
	Ord's Kangaroo Rat	<u>Dipodomys ordii</u>
	Western harvest mouse	<u>Reithrodontomys megalotis</u>
*	White-footed mouse	<u>Peromyscus leucopus</u>
	Deer mouse	<u>Peromyscus maniculatus</u>
	Northern grasshopper mouse	<u>Onychomys leucogaster</u>
	Bushy-tailed woodrat	<u>Neotoma cinerea</u>
	Meadow vole	<u>Microtus pennsylvanicus</u>
*	Prairie vole	<u>Microtus ochrogaster</u>
*	Longtail vole	<u>Microtus longicaudus</u>
*	Sagebrush vole	<u>Lagurus curtatus</u>
	Muskrat	<u>Ondatra zibethicus</u>
	Porcupine	<u>Erethizon dorsatum</u>

Lagomorpha

	White-tailed jack rabbit	<u>Lepus townsendii</u>
	Desert cottontail	<u>Sylvilagus audubonii</u>

¹

Taken from VTN Wildlife Report on Spring Creek Project

Appendix G-1

MAMMAL SPECIES LIST (cont.)

Artiodactyla

White-tailed deer
Mule deer
Pronghorn

Odocoileus virginianus
Odocoileus hemionus
Antilocapra americana

-
- * Designates species whose ranges overlap the study area but were not observed during the study.

Appendix G-1

AVIAN SPECIES LIST

Western Grebe	<u>Aechmophorus occidentalis</u>
White Pelican	<u>Pelecanus erythrorhynchos</u>
Double-crested Cormorant	<u>Phalacrocorax auritus</u>
Great Blue Heron	<u>Ardea herodias</u>
Canada Goose	<u>Branta canadensis</u>
White-fronted Goose	<u>Anser albifrons</u>
Mallard	<u>Anas platyrhynchos</u>
Gadwall	<u>Ansa strepera</u>
Pintail	<u>Anas acuta</u>
Green-winged Teal	<u>Anas carolinensis</u>
Blue-winged Teal	<u>Anas discors</u>
American Widgeon	<u>Mareca americana</u>
Northern Shoveler	<u>Spatula clypeata</u>
Redhead	<u>Aythya americana</u>
Ring-necked Duck	<u>Aythya collaris</u>
Lesser Scaup	<u>Aythya affinis</u>
Common Merganser	<u>Mergus merganser</u>
Turkey vulture	<u>Cathartes aura</u>
Goshawk	<u>Accipiter gentilis</u>
Sharp-shinned Hawk	<u>Accipiter striatus</u>
Red-tailed Hawk	<u>Buteo jamaicensis</u>
Red-tailed Hawk (Harlan's)	<u>Buteo jamaicensis</u>
Swainson's Hawk	<u>Buteo swainsonii</u>
Rough-legged Hawk	<u>Buteo lagopus</u>
Ferruginous Hawk	<u>Buteo regalis</u>
Golden Eagle	<u>Aquila chrysaetos</u>
Bald Eagle	<u>Haliaeetus leucocephalus</u>
Marsh Hawk	<u>Circus cyaneus</u>
Osprey	<u>Pandion haliaetus</u>
Prairie Falcon	<u>Falco mexicanus</u>
Peregrine Falcon	<u>Falco peregrinus</u>
Merlin	<u>Falco columbarius</u>
American Kestrel	<u>Falco sparverius</u>
Sharp-tailed Grouse	<u>Pedioecetes phasianellus</u>
Sage Grouse	<u>Centrocercus urophasianus</u>
Ring-necked Pheasant	<u>Phasianus colchicus</u>
Gray Partridge	<u>Perdix perdix</u>
American Coot	<u>Fulica americana</u>
Killdeer	<u>Charadrius vociferus</u>
Common Snipe	<u>Capella gallinago</u>
Long-billed Curlew	<u>Numenius americanus</u>
Upland Sandpiper	<u>Bartramia longicauda</u>
Spotted Sandpiper	<u>Actitis macularia</u>
Solitary Sandpiper	<u>Tringa solitaria</u>

Appendix G-1

AVIAN SPECIES LIST (cont.)

Willet	<u>Catoptrophorus semipalmatus</u>
Long-billed Dowitcher	<u>Limnodromus scolopaceus</u>
Wilson's Phalarope	<u>Steganopus tricolor</u>
Ring-billed gull	<u>Larus delawarensis</u>
Mourning Dove	<u>Zenaidura macroura</u>
Rock Dove	<u>Columba livia</u>
Great-horned Owl	<u>Bubo virginianus</u>
Short-eared Owl	<u>Asio flammeus</u>
Long-eared Owl	<u>Asio otus</u>
Poor-will	<u>Phalaenoptilus nuttallii</u>
Common Nighthawk	<u>Chordeiles minor</u>
Belted Kingfisher	<u>Megaceryle alcyon</u>
Common Flicker	<u>Colaptes auratus</u>
Red-headed Woodpecker	<u>Melanerpes erthrocephalus</u>
Lewis's Woodpecker	<u>Asyndesmus lewis</u>
Hairy Woodpecker	<u>Dendrocopos villosus</u>
Downy Woodpecker	<u>Dendrocopos pubescens</u>
Eastern Kingbird	<u>Tyrannus tyrannus</u>
Western Kingbird	<u>Tyrannus verticalis</u>
Say's Phoebe	<u>Sayornis saya</u>
Western Wood Pewee	<u>Contopus sordidulus</u>
Horned Lark	<u>Eremophila alpestris</u>
Violet-green Swallow	<u>Tachycineta thalassina</u>
Tree Swallow	<u>Iridoprocne bicolor</u>
Rough-winged Swallow	<u>Stelgidopteryx ruficollis</u>
Barn Swallow	<u>Hirundo rustica</u>
Cliff Swallow	<u>Petrochelidon pyrrhonota</u>
Black-billed Magpie	<u>Pica pica</u>
Common Raven	<u>Corvus corax</u>
Common Crow	<u>Corvus brachyrhynchos</u>
Pinyon Jay	<u>Gymnorhinus cyanocephalus</u>
Black-capped Chickadee	<u>Parus atricapillus</u>
White-breasted Nuthatch	<u>Sitta carolinensis</u>
Red-breasted Nuthatch	<u>Sitta canadensis</u>
Brown Creeper	<u>Certhia familiaris</u>
House Wren	<u>Troglodytes aedon</u>
Rock Wren	<u>Salpinctes obsoletus</u>
Sage Thrasher	<u>Oreoscoptes montanus</u>
American Robin	<u>Turdus migratorius</u>
Eastern Bluebird	<u>Sialia sialis</u>
Mountain Bluebird	<u>Sialia currucoides</u>
Townsend's Solitaire	<u>Myadestes townsendi</u>
Bohemian Waxwing	<u>Bombycilla garrulus</u>
Cedar Waxwing	<u>Bombycilla cedrorum</u>

Appendix G-1

AVIAN SPECIES LIST (cont.)

Starling
 Northern Shrike
 Loggerhead Shrike
 Yellow Warbler
 Yellow-rumped Warbler (Myrtle)
 Common Yellowthroat
 Wilson's Warbler
 Western Meadowlark
 Red-winged Blackbird
 Northern Oriole (Bullock's)
 Brewer's Blackbird
 Common Grackle

Black-headed Grosbeak
 Gray-crowned Rosy Finch
 Common Redpoll
 Pine Siskin
 American Goldfinch
 Rufous-sided Towhee
 Lark Bunting
 Savannah Sparrow
 Grasshopper Sparrow
 Baird's Sparrow
 Lark Sparrow
 Vesper Sparrow
 Dark-eyed Junco
 Tree Sparrow
 Chipping Sparrow
 Clay-colored Sparrow
 Brewer's Sparrow
 White-crowned Sparrow
 Fox Sparrow
 Song Sparrow
 Snow Bunting

Sturnus vulgaris
Lanius excubitor
Lanius ludovicianus
Dendroica petechia
Dendroica coronata
Geothlypis trichas
Wilsonia pusilla
Sturnella neglecta
Angelaus phoeniceus
Icterus galbula
Euphagus cyanocephalus
Quiscalus quiscula

Pheucticus melanocephalus
Leucosticte tephrocotis
Acanthis flammea
Spinus pinus
Spinus tristis
Pipilo erythrophthalmus
Calamospiza melanocorys
Passerculus sandwichensis
Ammodramus savannarum
Ammodramus bairdii
Chondestes grammacus
Poocetes gramineus
Junco hyemalis
Spizella arborea
Spizella passerina
Spizella pallida
Spizella breweri
Zonotrichia leucophrys
Passerella iliaca
Melospiza melodia
Plectrophenax nivalis

Appendix G-1

AMPHIBIAN AND REPTILE SPECIES

Urodela

* Blotched Tiger Salamander Ambystoma tigrinum

Anura

Boreal Chorus Frog Pseudacris triseriata maculata
 Leopard Frog Rana pipiens
 Rocky Mountain Toad Bufo woodhousei woodhousei
 * Plains Spadefoot Scaphiopus bombifrons
 Great Plains Toad Bufo cognatus

Testudina

* Snapping Turtle Chelydra serpentina
 Painted Turtle Chrysemys picta
 * Spiny Softshell Trionyx spiniferus

Squamata

Northern Sagebrush Lizard Sceloporus graciosus graciosus
 Eastern Short-horned Lizard Phrynosoma doulassi brevirostre
 Plains Hognose Snake Heterodon nasicus nasicus
 Eastern Yellow-bellied Racer Coluber constrictor flaviventris
 Bullsnake Pituophis melanoleucas sayi
 Prairie Rattlesnake Crotalus viridis viridis
 Red-sided Garter Snake Thamnophis sirtalis parietalis
 Wandering Garter Snake Thamnophis elegans vagrans
 * Western Plains Garter Snake Thamnophis radix haydeni
 * Pale Milk Snake Lampropeltis triangulum multistrata

* Designates species whose ranges overlap the study area but were not observed during the study.



United States Department of the Interior

FISH AND WILDLIFE SERVICE

P.O. Box 916
Sheridan, Wyoming 82801
307-672-5826

Appendix G-2

March 6, 1978

Mr. Douglas H. Hileman
Chief Mining Supervisor
U.S. Geological Survey
P.O. Box 2550
Billings, Montana 59101

Dear Mr. Hileman:

It has come to my attention from recent communications with NERCO personnel and Burt Rounds, Area Manager for the U.S. Fish and Wildlife Service, that there has been a considerable misunderstanding over the locations and status of golden eagle nests on a proposed NERCO mine in Big Horn County, Montana. We have been conducting intensive surveys of breeding birds of prey for 2 years in a region which includes the Spring Creek lease. I can perhaps clarify the eagle nest situation.

Only one eagle nest site exists on the immediate mining area (Section 19, T8S, R40E). This nest was active in 1977 but was destroyed by wind. Another golden eagle nest is located some 2 miles to the west of the proposed mine in Section 20, T8S, R39E. Two other nests were at one time or another incorrectly labeled as inactive golden eagle eyries and are located in Section 25, T8S, R39E and Section 32, T8S, R40E. Both of these nests are typically buteonine in construction and have not been occupied during the course of our investigation.

From a biological standpoint and aside from any legal constraints governing nest disturbances, it would be very difficult to assess the importance of the three nests located on the mine site. The destruction of the eagle

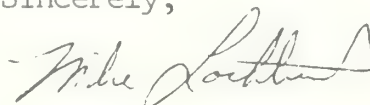


Save Energy and You Serve America!

nest on Spring Creek will not necessarily affect the viability of the pair which is still present by all indications. Nests of eagles are frequently destroyed only to be rebuilt in successive years. At this time I would personally attach little significance to the existence of the two buteo nests even though it is possible that the eagles may attempt to utilize one of these structures in the future.

I hope that this information will be helpful to you in considering proposed mine plans on Spring Creek.

Sincerely,

A handwritten signature in cursive script, appearing to read "Mike Lockhart".

J. Michael Lockhart
Wildlife Research Biologist

cc:

Mike Eidlin, NERCO

Ray Hoem, FWS

Burt Rounds, FWS

Len Ruggiero, VTN

Dick Juntunen, Montana State Lands

Gerry Gill, BLM

Appendix I-1

Montana Taxes.--State and local tax revenues for Montana in 1974 and 1976 fiscal years were \$427.56 million and \$536.399 million, respectively (Table A). Of the 1974 total, 54.3 percent was generated by the property tax, 18.4 percent by individual income tax, 8.3 percent by motor fuel taxes, 3.7 percent by corporate license and 2.7 percent by natural resource taxes. In 1976, 52.3 percent of the revenues was attributed to property tax, 18.2 percent to individual income tax, 7.7 percent to motor fuel tax, 4.3 percent to corporate license and 6.3 percent to natural resource tax. The trend appears to be a gradual replacement of property tax by severance tax and a greater reliance on the latter in the future.

The tax system for Montana for state and county jurisdiction by type of tax and maximum mill limit is presented in Table II-B-9. Tables II-B-10 and II-B-11 present a detailed account of tax levies, revenues, rates and valuations of Big Horn County from 1960 to 1974. In general, the data indicate increased assessed valuation, increased taxable valuations, increased revenues for state, county, schools, cemeteries, and municipalities with decreased rates and decreased levies.

Table A.--State and Local Tax Revenues, State of Montana, 1974
and 1976 fiscal years

	1974		1976	
	(\$000)	Percent	(\$000)	Percent
Total Taxes	427,560	100.0	536,399	100.0
Property	232,310	54.3	280,419	52.3
Individual Income	78,758	18.4	97,520	18.2
Motor Fuel, Total	35,451	8.3	41,246	7.7
Gasoline Licenses and Tax	28,406		32,939	
Diesel Fuel	6,635		7,915	
Aviation Fuel	363		356	
Liquefied Petroleum License and Tax	47		36	
Corporate License	15,638	3.7	23,020	4.3
Natural Resource, Total	11,530	2.7	33,923	6.3
Oil Producers License and Tax	4,256		6,564	
Coal License and Tax	3,315		22,924	
Metalliferous Mines	2,240		1,845	
Resource Indemnity Trust	1,138		1,981	
Natural Gas Distributors	407		446	
Cement and Gypsum	143		151	
Micaceous Mines	11		12	
Motor Vehicle <u>a/</u>	10,891	2.6	12,064	2.2
Cigarette and Tobacco	10,459	2.5	11,155	2.1
Alcoholic Beverages, Total <u>b/</u>	9,462	2.2	10,297	1.9
Wines and Spirits	5,730		5,900	
Beer License and Tax	2,214		2,250	
County License	1,202		1,778	
Liquor License	316		369	
Insurance	7,367	1.7	9,483	1.8
Inheritance	5,563	1.3	5,902	1.1
Motor Vehicle Registration	5,331 <u>c/</u>	1.3	5,748	1.1
Utility and Other Service License	2,383	0.6	2,705	0.5
Miscellaneous Business and Consumer License	1,283	0.3	1,663	0.3
Drivers and Chauffeur Licenses	1,154	0.3	1,254	0.2

a/ Includes GVW, motor carrier fees, and miscellaneous.

b/ Does not include profits from liquor stores of \$7,274,480.

c/ Figure is for 1975.

Source: Biennial Reports of the State Department of Revenue; information booklets of the Montana Department of Highways; Commerce Clearing House, State Tax Handbooks; letters and telephone conversations with departments of State government.

Table B.--Summary of Montana tax laws for state and county jurisdiction
for 1974

	Mill Limit
<u>State Property Taxes</u>	
General Fund	2.0
University Fund	6.0
Statewide Deficiency Levy for Public Schools	As Needed
Statewide Public School Supplemental Permissive Levy	9.0
Special Livestock	9.0
Property Tax Administration (Repealed)	—
Total	21.0
<u>County Property Taxes</u>	
General Fund	25.0-27.0
Poor Fund	13.5
Bond Sinking and Interest	As Necessary
Road	12.0
Emergency Levies	2.0
Employee Retirement	
Bridge Tax	3.0-5.0
Special Bridge and Road Tax	10.0-5.0
Airport Tax	2.0
Airport Authority	No Limit
Public Ferry Tax	2.0
County Fair Tax	1.5
Library Tax	3.0
Rodent Control Tax	2.0
Insect Pest Tax	1.0
Weed Control	2.0
Extension Work in Agriculture and Home Economics	No Limit
Fire Districts	As Necessary
Soil Conservation Districts	1.5
Conserving Districts	2.0-5.0
Cemetery	2.0
Local Boards of Health County	2.0
Museum Fund Tax	0.5
Mosquito Control District	5.0
Planning and Zoning	2.0-6.0
Hospital Districts	3.0
County Park Commission	As Needed
Civic Center Tax	2.0
Special Improvement Districts	
Ambulance Services Levy	1.0
Recreational Program - Elderly	1.0

Table C.---Tax levies - Big Horn County, Montana
1969-1974

	1969		1970		1971		1972		1973		1974	
	Detail	Total	Detail	Total	Detail	Total	Detail	Total	Detail	Total	Detail	Total
State Levies												
General Fund	2.00	8.20	2.00	8.30	0	6.10	0	6.00	0	21.00	0	6.00
All Other	6.20		6.30		6.10		6.00		21.00		6.00	
Livestock Levies												
Sheep	12.00		12.00		12.00		11.00		11.50		11.50	
All Other Livestock	10.50		10.50		10.00		10.00		10.50		10.50	
County Levies												
General Fund	13.30	21.26	14.50	24.67	17.26	34.04	19.47	33.75	18.75	31.36	10.06	18.80
Debt Service	0		0		6.00		0.89		0.45		0.71	
All Other Levies	7.96		10.17		10.78		13.39		12.16		8.03	
Special County Levies												
Planning	0	55.36	0.33	56.82	0.14	59.40	0.26	60.85	1.26	66.53	1.61	57.80
Roads	6.38		6.26		10.11		10.53		10.86		7.92	
Countywide Schools	48.98		49.44		48.76		49.67		53.64		47.91	
All Other	0		0.79		0.39		0.39		0.77		0.36	
School District Levies												
District #1	9.99		4.27		11.57		6.45		9.06		2.68	
2	16.82		13.95		16.59		23.75		19.12		15.43	
16	29.83		20.98		33.87		27.13		26.74		26.17	
17H	23.23		31.29		59.39		49.26		35.81		36.30	
17K	10.22		13.62		25.90		26.72		13.23		32.52	
27	16.64		17.24		27.36		32.64		29.26		20.92	
29	22.68		37.55		32.93		42.60		33.93		26.67	
City Levies												
Hardin		44.81		51.39		49.66		51.12		57.25		62.50
General Fund	5.92		9.68		7.60		8.33		48.00		55.50	
Debt Service	3.53		3.83		2.40		2.27		2.25		2.00	

Table C.--(Cont.)

	1969		1970		1971		1972		1973		1974	
	Detail	Total	Detail	Total	Detail	Total	Detail	Total	Detail	Total	Detail	Total
All Other	35.36		36.88		38.66		40.02		7.00		5.00	
City-County Planning	0		1.00		1.00		0.50		0		0	
Lodge Grass		60.00		60.00		60.00		60.00		60.00		65.00
General Fund	24.00		24.00		24.00		24.00		24.00		65.00	
Debt Service	0		0		0		0		0		0	
All Other	36.00		36.00		36.00		36.00		36.00		0	
Cemeteries												
District 1 (17H and 16)	0.54		1.62		0.89		Nil		1.15		1.11	
District 2 (27 and 29)	1.02		0.62		0.90		0.96		0.81		1.03	

Table D.--Tax revenues, rates, and valuations, Big Horn County, Montana
1969, 1971, 1973, and 1974

	1969		1971		1973		1974	
	Rates	Revenues	Rates	Revenues	Rates	Revenues	Rates	Revenues
District 1 (Decker Area)								
State	8.20	4,909	6.10	3,926	21.00	23,707	6.00	71,963
County	76.62	45,873	93.44	60,133	97.89	110,509	76.60	918,722
School	9.99	5,981	11.57	7,446	9.06	10,228	2.68	32,143
Total	94.81	56,763	111.11	71,505	127.95	144,444	85.28	1,022,828
Assessed Valuation	2,074,563		2,291,124		6,054,041		16,624,243	
Taxable Valuation	598,708		643,547		1,128,910		11,993,754	
District 2 (Pryor Area)								
State	8.20	5,803	6.10	4,534	21.00	17,517	6.00	5,468
County	76.62	54,219	93.44	69,457	97.89	81,654	76.60	69,805
School	16.82	11,902	16.59	12,332	19.12	15,949	15.43	14,061
Total	101.64	71,924	116.13	86,323	138.01	115,120	98.03	89,334
Assessed Valuation	2,321,594		2,382,339		2,718,166		2,954,788	
Taxable Valuation	707,629		743,336		834,137		911,292	
District 16 (North Hardin)								
State	8.20	6,146	6.10	4,842	21.00	18,337	6.00	5,774
County	76.62	57,423	93.44	74,164	97.89	85,478	76.60	73,712
School	29.83	22,356	33.87	26,883	26.74	23,350	26.17	25,183
Cemetery	0.54	405	0.89	706	1.15	1,004	1.11	1,068
Total	115.19	86,330	134.30	106,595	146.78	128,169	109.88	105,737

Table D.--(Cont.)

	1969		1971		1973		1974	
	Rates	Revenues	Rates	Revenues	Rates	Revenues	Rates	Revenues
Assessed Valuation	2,629,750		2,794,688		3,013,617		3,322,370	
Taxable Valuation	749,456		793,703		873,205		962,295	
District 17H (Hardin Area)								
State	8.20	67,532	6.10	51,902	21.00	187,502	6.00	66,122
County	76.62	631,019	93.44	795,033	97.89	874,027	76.60	883,463
School	23.23	191,315	59.39	505,319	35.81	319,736	36.30	418,191
Cemetery	0.54	4,447	0.89	7,573	1.15	10,267	1.11	12,788
Total	108.59	894,313	159.82	1,359,827	155.85	1,391,532	120.01	1,379,564
Assessed Valuation	30,630,525		31,262,501		32,793,462		40,633,612	
Taxable Valuation	8,235,699		8,508,487		8,928,671		11,520,411	
Hardin, City of	44.81	102,611	49.66	122,344	57.25	149,882	62.50	185,002
Assessed Valuation	8,742,175		8,515,506		10,387,855		11,221,575	
Taxable Valuation	2,289,023		2,463,635		2,618,028		2,960,026	

Wyoming Taxes.--Wyoming tax sources were \$273.167 million in fiscal year 1974-75, compared with \$333.750 million in 1975-76 (Table E). Of the 1974-75 total, 48 percent was accounted for by property tax, 22 percent from sales tax, 5 percent from user tax, 7 percent from gasoline tax, and 7 percent from mineral severance tax. For the 1975-76 total, 47 percent was accounted for by property tax, 22 percent from sales taxes, 4 percent from gasoline tax, and 12 percent from mineral severance tax.

Each State within the impacted area has special provisions in terms of levies and mill rates as well as special provisions for inter-governmental flows to local units of government of the county, town, and school district levels.

Table E.--Tax and other general revenue from own sources, State and Local government in Wyoming 1974-5 and 1975-6 Fiscal Years a/

Source of Revenue	1974-5 (\$000)	1975-6 (\$000)
Total General Revenue from Own Sources	319,092	<u>b/</u>
Taxes from Own Sources, Total	273,167	333,750
Property	131,083	156,681
Sales	60,203	73,900
Use	12,863	14,037
Gasoline	20,217	22,421
Compensatory and Other Motor Related	13,631	15,263
State Motor Vehicle Registration	3,672	4,596
County Motor Vehicle Registration	6,912	<u>b/</u>
Mineral Severance	18,175	40,335
Coal Excise	<u>c/</u>	282
Cigarette	4,248	4,526
Inheritance	1,575	1,426
Insurance Companies	3,058	283
Alcoholic Beverages	1,161	<u>b/</u>
Other Revenues from Own Sources	45,925	<u>b/</u>
Liquor Commission Profits	1,664	
Mineral Royalties	29,385	
State Lands Income	8,389	
Employment Insurance	6,487	

a/ Data are compiled from several sources which may not be consistent in method of reporting. Amounts levied and collected differ due to delinquencies and refunds. Costs of administration are deducted in some reports but not others. Property taxes are levied in one year but collected in another.

b/ Not available.

c/ Initiated in 1975.

Table F.--Taxes collected, mill levy and assessed valuation for 1964,
1967 and 1970 to 1974 for City of Sheridan, Wyoming

Year	Assessed Valuation	Mill Levy ¹	Taxes Collected
1974	\$17,668,165	12.96	\$228,978
1973	16,978,063	12.81	217,998
1972	16,435,373	13.73	225,657
1971	15,676,912	14.08	220,731
1970	15,807,480	14.42	227,943
1967	15,744,732	14.58	229,559
1964	15,329,079	11.71	179,502

¹The total tax burden to property within the corporate limits of
Sheridan is as follows:

	<u>Mills</u>
City Taxes	12.96
School Taxes*	47.66
County Taxes	10.20
Special Districts	1.32

*Including State Foundation Fund

TABLE G
1977 Property Valuation for
Wyoming School Districts

	<u>Valuation per AUM</u>
Richest District	\$175,560
Statewide Average	30,854
District #1	14,034
District #2	12,865
Poorest District	10,216

TABLE H
Source of School Revenue, 1976-77
Sheridan School Districts
(\$000,000)

	<u>Total*</u>	<u>Local %</u>	<u>County %</u>	<u>State %</u>	<u>Federal %</u>
Dist. 1	1.2	.29 24	.16 13	.74 61	.02 2
Dist. 2	4.7	1.30 26	.67 14	2.80 58	.09 2

*Excluding Cash on Hand

APPENDIX I-2.--"Coal Town II" model projections, Big Horn and Sheridan Counties, without Spring Creek mine

The following additional information is made available from the Coal Town II model as described in chapter II (Economics).

TABLE A.--Million tons of coal mined by year, 1978-90

It was assumed that the following tonnage increases would be mined in Big Horn and Sheridan Counties. Baseline represents production from existing mines¹; 10 mt/y includes Spring Creek mine at original level, 7 mt/y includes Spring Creek mine at the reduced level proposed under the "Central Mine Field Plan".

Year	Baseline			10 mt/y			7 mt/y		
	Big Horn County	Sheridan County	Total (mt/y)	Big Horn County	Sheridan County	Total (mt/y)	Big Horn County	Sheridan County	Total (mt/y)
1978--	16.5	1.4	17.9	16.5	1.4	17.9	16.5	1.4	17.9
1979--	20.0	2.5	22.5	20.0	2.5	22.5	20.0	2.5	22.5
1980--	24.9	2.5	27.4	27.9	2.5	30.4	26.9	2.5	29.4
1981--	30.0	2.5	32.5	37.0	2.5	39.5	36.0	2.5	38.5
1982--	30.0	2.5	32.5	40.0	2.5	42.5	37.0	2.5	39.5
1983--	33.0	2.5	35.5	43.0	2.5	45.5	40.0	2.5	42.5
1984--	33.5	2.5	36.0	43.5	2.5	46.0	40.5	2.5	43.0
1985--	33.5	2.5	36.0	43.5	2.5	46.0	40.5	2.5	43.0
1986--	33.5	2.5	36.0	43.5	2.5	46.0	40.5	2.5	43.0
1987--	33.5	2.5	36.0	43.5	2.5	46.0	40.5	2.5	43.0
1988--	33.5	2.5	36.0	43.5	2.5	46.0	40.5	2.5	43.0
1989--	33.5	2.5	36.0	43.5	2.5	46.0	40.5	2.5	43.0
1990--	33.5	3.8	37.3	43.5	3.8	47.3	40.5	3.8	44.3

TABLE B.--County net migration estimates, 1978-90

Year	Big Horn County			Sheridan County		
	Baseline	10 mt/y	7 mt/y	Baseline	10 mt/y	7 mt/y
1978---	134	134	134	313	313	313
1979---	-71	-71	-71	-248	248	248
1980---	33	33	33	221	-19	-19
1981---	228	228	228	215	369	369
1982---	111	111	111	239	264	264
1983---	116	116	116	265	284	284
1984---	127	127	127	293	312	312
1985---	133	133	133	316	335	335
1986---	174	174	174	413	433	433
1987---	177	177	177	432	452	452
1988---	181	181	181	454	474	474
1989---	183	183	183	471	491	491
1990---	688	688	688	1,564	1,609	1,609

¹In Big Horn County, Decker West, East and North, and Westmoreland Tract II. In Sheridan County, the Big Horn mine.

TABLE C

Estimates were also made of the response of the average ancillary wage during the period 1978-90 to the different production scenarios. The estimates are based on a constant dollar and expressed as a proportion of 1974 average ancillary wage.

Year	Big Horn County	Sheridan County		
		Base	10 mt/y	7 mt/y
1978----	.8018	.8044	.8044	.8044
1979----	.9408	.8044	.8379	.8379
1980----	.8910	.9784	.8044	.8044
1981----	.8205	.9007	.9809	.9809
1982----	.7569	.9142	.8753	.8753
1983----	.8813	.9195	.9219	.9219
1984----	.9670	.9242	.9281	.9281
1985----	.8205	.9266	.9304	.9304
1986----	.9015	.9543	.9575	.9575
1987----	.8934	.9423	.9457	.9457
1988----	.8986	.9458	.9491	.9491
1989----	.9006	.9471	.9503	.9503
1990----	1.0439	1.0813	1.0834	1.0834

TABLE D

Employment to population estimates are also made available below. The ratio can be used as an indicator of participation rates over time.

Employment/population ratios 1978-90

Year	Big Horn County	Sheridan County		
		Base	10 mt/y	7 mt/y
1978----	.425	.473	.473	.473
1979----	.429	.471	.482	.482
1980----	.435	.480	.485	.485
1981----	.440	.483	.491	.491
1982----	.443	.487	.494	.494
1983----	.445	.490	.497	.497
1984----	.446	.493	.499	.499
1985----	.448	.495	.502	.502
1986----	.448	.496	.503	.503
1987----	.448	.498	.503	.503
1988----	.448	.500	.504	.504
1989----	.447	.500	.505	.505
1990----	.430	.482	.487	.487

TABLE E.--State net revenues generated by county - constant dollars 1978-90

Year	Big Horn County			Sheridan County		
	Baseline	10 mt/y	7 mt/y	Baseline	10 mt/y	7 mt/y
1978----	20,010,680	20,010,680	20,010,680	1,919,905	1,919,905	1,919,905
1979----	23,809,274	23,809,274	23,809,274	2,756,278	2,880,700	2,880,700
1980----	30,135,991	33,504,206	32,381,468	2,757,387	2,757,069	2,757,069
1981----	35,792,226	43,565,894	42,454,519	2,769,514	2,884,231	2,884,231
1982----	34,790,689	45,750,636	42,462,955	2,812,722	2,886,858	2,886,858
1983----	38,120,747	48,971,312	45,715,680	2,853,849	2,942,823	2,942,823
1984----	38,561,048	49,351,290	46,113,731	2,895,521	2,985,228	2,985,228
1985----	38,467,553	49,203,899	45,982,553	2,937,586	3,027,458	3,027,458
1986----	38,357,503	49,038,055	45,833,497	2,984,535	3,074,470	3,074,470
1987----	38,166,176	48,808,681	45,615,558	3,018,552	3,108,723	3,108,723
1988----	38,109,315	48,714,059	45,532,297	3,060,022	3,150,462	3,150,462
1989----	38,039,954	48,605,414	45,435,411	3,102,572	3,193,364	3,193,364
1990----	38,457,096	48,985,957	45,826,990	4,142,801	4,232,387	4,232,387

TABLE F.--Per capita town revenues - constant dollars 1978-90

Year	Big Horn County			Sheridan County		
	Baseline	10 mt/y	7 mt/y	Baseline	10 mt/y	7 mt/y
1978-----	81	81	81	83	83	83
1979-----	78	78	78	85	86	86
1980-----	77	77	77	85	84	84
1981-----	75	75	75	85	86	86
1982-----	73	73	73	85	85	85
1983-----	72	72	72	85	86	86
1984-----	71	71	71	85	86	86
1985-----	70	70	70	85	86	86
1986-----	68	68	68	85	86	86
1987-----	67	67	67	85	86	86
1988-----	65	65	65	85	85	85
1989-----	64	64	64	85	85	85
1990-----	61	61	61	86	86	86

TABLE G.--School district net revenues* - constant dollars 1978-90

Year	Big Horn County			Sheridan County		
	Baseline	10 mt/y	7 mt/y	Baseline	10 mt/y	7 mt/y
1978-----	2,801,515	2,801,515	2,801,515	6,113,265	6,113,265	6,113,265
1979-----	3,202,965	3,202,965	3,202,965	6,221,202	6,352,411	6,352,411
1980-----	3,762,055	3,997,224	4,114,808	6,316,977	6,386,401	6,386,401
1981-----	4,317,106	5,015,704	5,131,794	6,411,593	6,521,600	6,521,600
1982-----	4,261,377	5,065,185	5,410,539	6,513,113	6,630,566	6,630,566
1983-----	4,560,207	5,353,741	5,694,770	6,622,417	6,745,419	6,745,419
1984-----	4,584,309	5,370,624	5,708,494	6,739,790	6,868,435	6,868,435
1985-----	4,553,707	5,333,456	5,668,447	6,864,134	6,998,468	6,998,468
1986-----	4,525,313	5,298,677	5,630,867	7,014,193	7,154,640	7,154,640
1987-----	4,503,082	5,271,263	5,601,178	7,170,618	7,317,217	7,317,217
1988-----	4,482,175	5,245,431	5,573,181	7,333,973	7,486,779	7,486,779
1989-----	4,461,931	5,220,391	5,546,039	7,503,026	7,662,081	7,662,081
1990-----	4,459,477	5,213,490	5,537,194	8,109,980	8,281,463	8,281,463

*Assumes a constant voted mill levy.

TABLE H.--School district spending - constant dollars 1978-90

Year	Big Horn County			Sheridan County		
	Baseline	10 mt/y	7 mt/y	Baseline	10 mt/y	7 mt/y
1978-----	2,104,055	2,104,055	2,104,055	5,839,260	5,839,260	5,839,260
1979-----	2,102,301	2,102,301	2,102,301	5,808,834	5,936,957	5,936,957
1980-----	2,120,626	2,120,626	2,120,626	5,899,320	5,966,376	5,966,376
1981-----	2,177,337	2,177,337	2,177,337	5,988,885	6,095,997	6,095,997
1982-----	2,211,429	2,211,429	2,211,429	6,085,058	6,199,252	6,199,252
1983-----	2,246,681	2,246,681	2,246,681	6,188,649	6,308,223	6,308,223
1984-----	2,284,065	2,284,065	2,284,065	6,299,950	6,424,992	6,424,992
1985-----	2,322,995	2,322,995	2,322,995	6,417,835	5,548,362	5,548,362
1986-----	2,370,086	2,370,086	2,370,086	6,561,341	6,697,796	6,697,796
1987-----	2,418,132	2,418,132	2,418,132	6,710,684	6,853,083	6,853,083
1988-----	2,467,135	2,467,135	2,467,135	6,866,560	7,014,939	7,014,939
1989-----	2,516,703	2,516,703	2,516,703	7,027,683	7,182,078	7,182,078
1990-----	2,664,726	2,664,726	2,664,726	7,471,624	7,638,272	7,638,272

TABLE I.--County net revenue* - constant dollars 1978-90

Year	Big Horn County			Sheridan County		
	Baseline	10 mt/y	7 mt/y	Baseline	10 mt/y	7 mt/y
1978-----	1,029,854	1,029,854	1,029,854	931,526	931,526	931,526
1979-----	1,227,540	1,227,540	1,227,540	1,016,353	1,040,974	1,040,974
1980-----	1,097,741	1,168,671	1,204,136	1,029,340	1,030,981	1,030,981
1981-----	1,266,083	1,476,790	1,511,804	1,036,587	1,059,491	1,059,491
1982-----	1,250,746	1,493,186	1,597,349	1,049,914	1,066,340	1,066,340
1983-----	1,342,127	1,581,468	1,684,327	1,063,509	1,082,791	1,082,791
1984-----	1,350,468	1,587,631	1,689,538	1,077,855	1,097,609	1,097,609
1985-----	1,342,250	1,577,433	1,678,470	1,092,808	1,112,944	1,112,944
1986-----	1,334,548	1,567,805	1,667,998	1,111,029	1,131,534	1,131,534
1987-----	1,328,646	1,560,340	1,659,837	1,127,630	1,148,585	1,148,585
1988-----	1,323,126	1,553,334	1,652,188	1,145,971	1,167,367	1,167,367
1989-----	1,317,799	1,546,561	1,644,782	1,164,903	1,186,761	1,186,761
1990-----	1,316,466	1,543,888	1,641,521	1,310,806	1,333,042	1,333,042

*Assumes a constant mill levy.

TABLE J.--County spending* - constant dollars 1978-90

Year	Big Horn County			Sheridan County		
	Baseline	10 mt/y	7 mt/y	Baseline	10 mt/y	7 mt/y
1978-----	670,675	670,675	670,675	4,493,488	4,493,488	4,493,488
1979-----	670,306	670,306	670,306	4,471,403	4,564,344	4,564,344
1980-----	674,146	674,146	674,146	4,537,052	4,585,665	4,585,665
1981-----	685,959	685,959	685,959	4,601,981	4,679,556	4,679,556
1982-----	693,010	693,010	693,010	4,671,635	4,754,262	4,754,262
1983-----	700,261	700,261	700,261	4,746,594	4,833,030	4,833,030
1984-----	707,909	707,909	707,909	4,827,053	4,917,345	4,917,345
1985-----	715,827	715,827	715,827	4,912,181	5,006,340	5,006,340
1986-----	725,345	725,345	725,345	5,015,693	5,113,998	5,113,998
1987-----	734,990	734,990	734,990	5,123,277	5,225,731	5,225,731
1988-----	744,760	744,760	744,760	5,235,418	5,342,035	5,342,035
1989-----	754,575	754,575	754,575	5,351,184	5,461,976	5,461,976
1990-----	783,500	783,500	783,500	5,669,382	5,788,544	5,788,544

*Based upon the relationship between county population and county spending levels in 181 Northern Great Plains counties in 1972. The estimates are more useful as an indicator of the trend of needed spending than as a predictor of actual county spending.

TABLE K.--Annual percentage growth rates of revenues and spending; county - constant dollars 1978-90

Year	Big Horn County				Sheridan County			
	Baseline		10 mt/y		Baseline		10 mt/y	
	Revenues	Spending	Revenues	Spending	Revenues	Spending	Revenues	Spending
1978--	5.6	1.2	5.6	1.2	-4.6	1.9	-4.6	1.9
1979--	19.2	0	19.2	0	9.1	-0.5	11.7	1.6
1980--	-10.6	0.6	-1.9	0.6	1.3	1.5	-1.0	0.5
1981--	15.3	1.8	25.6	1.8	0.7	1.4	2.8	2.0
1982--	-1.2	1.0	5.7	1.0	1.3	1.5	0.6	1.6
1983--	7.3	1.0	5.4	1.0	1.3	1.6	1.5	1.7
1984--	0.6	1.1	0.3	1.1	1.3	1.7	1.4	1.7
1985--	-0.6	1.1	-0.7	1.1	1.4	1.8	1.4	1.8
1986--	-0.6	1.3	-0.6	1.3	1.7	2.0	1.7	2.2
1987--	-0.4	1.3	-0.5	1.3	1.5	2.1	1.5	2.2
1988--	-0.4	1.3	-0.5	1.3	1.6	2.2	1.6	2.2
1989--	-0.4	1.3	-0.4	1.3	1.7	2.2	1.7	2.2
1990--	-0.1	3.8	-0.2	3.8	12.5	5.9	12.3	6.0

TABLE L.--Annual percentage growth rates of revenues and spending; school district - constant dollars 1978-90

Year	Big Horn County				Sheridan County			
	Baseline		10 mt/y		Baseline		10 mt/y	
	Revenues	Spending	Revenues	Spending	Revenues	Spending	Revenues	Spending
1978--	-0.7	1.8	-0.7	1.8	1.8	2.0	1.8	2.0
1979--	14.3	0	14.3	0	14.3	0	1.8	-0.5
1980--	17.5	0.9	28.5	0.9	1.5	1.6	0.5	0.5
1981--	14.8	2.7	24.7	2.7	1.5	1.5	2.1	2.2
1982--	-1.3	1.6	5.4	1.6	1.6	1.6	1.7	1.7
1983--	7.0	1.6	5.3	1.6	1.7	1.7	1.7	1.7
1984--	0.5	1.7	0.2	1.7	1.8	1.8	1.8	1.9
1985--	-0.7	1.7	-0.7	1.7	1.8	1.9	1.9	1.9
1986--	-0.6	2.0	-0.7	2.0	2.2	2.2	2.2	2.3
1987--	-0.5	2.0	-0.5	2.0	2.2	2.3	2.3	2.3
1988--	-0.5	2.0	-0.5	2.0	2.3	2.3	2.3	2.4
1989--	-0.5	2.0	-0.5	2.0	2.3	2.3	2.3	2.3
1990--	-0.1	5.9	-0.2	5.9	8.1	6.3	8.1	6.4

Appendix I-4.--Coal Board grants

Number	Project	Grant
0002/0003	Colstrip School Equipment	\$ 93,696.97
0002	Colstrip Elementary School	661,297.00
0003	Colstrip High School	428,455.00
0004	Ashland Elementary School	800,000.00
0005	Rosebud School District	465,000.00
0006	Rosebud County Planning	32,000.00
0007	Forsyth Elementary School	2,500,000.00
0008	Forsyth High School	27,000.00
0009	Forsyth Water Treatment	615,000.00
0010	Forsyth Wastewater Pump	150,000.00
0012	Forsyth Sewage	25,000.00
0014	Colstrip Sewage Treatment	538,000.00
0015	Ashland Water & Sewer	71,080.00
0016	Rosebud County Jail	100,000.00
0017	Hardin Sewer & Lagoon	266,475.00
0018	Hardin Capital Equipment	128,154.76
0019	Lodge Grass Capital Equip.	125,250.00
0020	Hysham Water Distribution	388,440.00
0022	16th Judicial District	24,829.23
0024	Lodge Grass Water Line	171,556.18
0027	Forsyth Capital Equipment	154,682.53
0028	Hardin Elementary School	2,041,647.99
0029	Hardin High School	1,167,999.99
0030	Treasure County Health Nurse	9,355.00
0031	Sage Brush Library	51,272.00
0033	Miles Community College	1,529,663.00
0037	Colstrip Street Cleaner	82,102.56
0038	Colstrip Water Treatment	656,600.00
0042	Dawson County Census	11,108.34
0043	McCone County Planning	42,500.00
0046	Hardin Water System	260,900.00
0047	Hardin Sewer	416,978.55
0054	Laurel Public Schools	228,825.00
0055	Hysham Sewer System	56,500.00
0056	Laurel Water Treatment	483,772.00
0057	Forsyth Municipal Water	87,000.00
0058	Forsyth Capital Equipment	44,273.06
0059	Colstrip Elem. School Equip.	38,544.70
0060	Rosebud County Sewer	51,000.00
0061	Treasure County Patrol Car	6,667.31
0062	Ashland Vol. Fire Dept.	44,741.00
0063	Lodge Grass Capital Equip.	60,619.95
0064	Forsyth Solid Waste	145,000.00
0068	Tri-County Solid Waste	289,859.56
0069	Big Horn County Courthouse	416,000.00
0072	Hysham Capital Equipment	50,000.00
0074	Custer County Water & Sewer	358,000.00
0075	Forsyth Elem. & High School	193,230.00
0076	Forsyth Elem. & High School	291,590.22
0078	Hardin Capital Equipment	57,388.00
0079	Treasure County Planning	17,000.00
0080	Colstrip Community Ser. Facility	324,526.00
0081	Forsyth Capital Equip./Truck	27,000.00
0083	Big Horn Co. Rural Fire Equip.	75,000.00
0085	Ashland Water & Sewer District	51,472.00
	Total as of January 1979-----	\$17,355,572.68
1/79 0090	Lame Deer Schools/Comprehensive Plan	18,420.00
	Total-----	\$17,373,992.78

Tabled, deferred, and denied projects

Number	Project	Grant
0001 -	Lame Deer School District (DEN.) 2/76	\$ 6,000
0011 -	Forsyth Swimming Pool (DEN.) 3/76	200,000
0013 -	Forsyth/Oak Street Arterial (DEN.) 3/76	50,000
0021 -	Miles City/Haynes Ave. Wastewater Improvements (DEN.) 6/76	600,000
0023 -	Ashland Medical Clinic (DEN.) 4/76	5,409
0025 -	Forsyth Pedestrian Overpass (DEN.) 7/76	115,000
0026 -	Rosebud County Coordinated Youth Center (DEN.) 7/76	5,058
0032 -	McCone County Airport (T) 9/76	599,725
0034 -	McCone County Brockway Water & Sewer System (T) 9/76	2,500
0035 -	Circle High School District #1 (T) 9/76	900,000
0036 -	Musselshell Co./Roundup Airport Development (DEN.) 7/76	50,000
0039 -	Rosebud Co. - Water/Sewer Mains & Streets (DEN.) 10/76	603,885
0040 -	Colstrip Elem. Sch. Dist. #19/Personnel Housing (DEF.) 10/76	947,398
0041 -	Colstrip H.S. Dist. #19/Personnel Housing (DEF.) 10/76	874,522
0044 -	McCone Co./High School District #1 (DEN.) 1/77	25,000
0045 -	Dawson College (DEN.) 1/77	538,000
0048 -	Wibaux Water Well (T) 1/77	88,000
0049 -	Wibaux Water Distribution System (T) 1/77	201,000
0050 -	Wibaux Storage Reservoir (T) 1/77	250,000
0051 -	Rosebud County Planning Board (DEN.) 1/77	22,000
0052 -	Treasure County/Hysham Airport (T) 2/77	178,532
0053 -	Custer County Water & Sewer (DEN.) 7/77	1,650,000
0065 -	Hardin Minibus (DEN.) 7/77	9,900
0066 -	Billings Impact Study (DEN.) 7/77	95,000
0067 -	Ashland Comprehensive Building & Clinic (DEN.) 7/77	143,520
0070 -	Squirrel Creek School Bus (DEN.) 9/77	9,890
0071 -	Ashland Teacher Housing (DEN.) 11/77	114,000
0073 -	16th Judicial District Probation Officer (DEN.) 11/77	43,200
0082 -	Forsyth Municipal Street Paving (DEN.) 8/78	3,200,000
0087 -	Treasure County Shop Complex (T) 11/78	335,000
0088 -	Hardin Street Paving, Curb & Gutter (DEN.) 11/78	755,655
Total as of January 1979-----		\$12,618,194

JANUARY COAL BOARD MEETING - 1/18-19/79

0084 -	Big Horn County Substance Abuse/Mental Illness Study (D)	44,000
0086 -	Forsyth Public Schools/Remodeling & Equipment (T)	65,000
0089 -	Hardin Capital Equipment/Black Topper & Truck (T)	32,400
0091 -	Montana State Library Collection Devel. & Equip. (T)	283,600
0092 -	City of Livingston/Capital Equipment (T)	150,000
Total-----		\$ 13,193,194

TABLE M.--Estimated number of students per county 1978-90

Year	Big Horn County			Sheridan County		
	Baseline	10 mt/y	7 mt/y	Baseline	10 mt/y	7 mt/y
1978---	2,785	2,785	2,785	5,904	5,904	5,904
1979---	2,783	2,783	2,783	5,873	6,003	6,003
1980---	2,808	2,808	2,808	5,965	6,033	6,033
1981---	2,884	2,884	2,884	6,056	6,165	6,165
1982---	2,330	2,330	2,330	6,154	6,270	6,270
1983---	2,977	2,977	2,977	6,259	6,381	6,381
1984---	3,028	3,028	3,028	6,372	6,500	6,500
1985---	3,080	3,080	3,080	6,492	6,625	6,625
1986---	3,144	3,144	3,144	6,638	6,777	6,777
1987---	3,209	3,209	3,209	6,790	6,935	6,935
1988---	3,275	3,275	3,275	6,949	7,100	7,100
1989---	3,342	3,342	3,342	7,113	7,270	7,270
1990---	3,542	3,542	3,542	7,565	7,734	7,734

TABLE N.--Price index

Some of the tables contained in this document are reported in current rather than constant dollars. The following is the price index used to represent future inflation, 1970 = 100.

1978---	165.7	1984---	236.6
1979---	175.8	1985---	249.9
1980---	186.4	1986---	264.0
1981---	198.3	1987---	278.5
1982---	211.2	1988---	293.8
1983---	223.9	1989---	310.0
		1990---	327.0



MONTANA HISTORICAL SOCIETY

225 NORTH ROBERTS STREET • (406) 449-2694 • HELENA, MONTANA 59601

July 12, 1978

Mr. Edwin Zaidlicz
State Director
Bureau of Land Management
Granite Tower
Billings, Montana 59101

RE: NERCO Spring Creek Mine
Cultural Resources Compliance

Dear Mr. Zaidlicz:

I have reviewed the letter dated October 17, 1977, from Robert A. Teegarden, District Manager, BLM, Miles City, Montana, to Doug Hileman, Area Mining Supervisor, USGS, Billings, Montana, and its applicability to Section 106 of the Historic Preservation Act. Although, for the most part, I agree with its contents, certain requirements have been omitted, and I have interjected them where appropriate. Also, in order to clarify a situation which has led to problems in the proposed Spring Creek project, I have added a few phrases. The view of this office is that the following will constitute compliance:

1. A 100% intensive survey for the identification of cultural resources will be completed in the entire EIS boundary and right-of-way access corridors, as required by Executive Order 11593. The survey will be conducted in accordance with BLM Manual 8111.14B for Class III intensive inventory (see attached). It is my understanding that all lands within the EIS boundary have received this intensive inventory except: W 1/2 W 1/2, SE 1/4 SW 1/4, Section 30, T. 8 S., R. 40 E. N 1/2 NE 1/4, Section 23, T. 8 S., R. 39 E.

The entire inventory will be addressed in the EIS.

Although State Lands guidelines recommend surveying of a one-mile buffer zone, this guideline was waived by State Lands because it was established following submittal of the Spring Creek Mining and Reclamation Plan.

2. Identify and address the cultural resources which potentially will be impacted as a result of the proposed Central Field Mine Plan. The area of concern includes the proposed permit area shown on Plate 13 (Bonding Permit Map-Spring Creek Coal Field, dated 4-12-78), BLM Coal Lease M-069782 and associated transportation corridors.

Mr. Edwin Zaidlicz

July 12, 1978

3. All sites identified in the impact area will be evaluated by complete field recording and/or testing to determine subsurface potential, and to determine if criteria are met for listing on the National Register of Historic Places. (The 23 sites in the Fox-Taylor 1977 report which do not meet the criteria do not require further consideration beyond the identification phase.)

Although testing for buried deposits where no surface evidence exists is not a legal requirement, we concur with the recommendation of BLM to use this technique as a means of identifying sites which cannot be located by surface examination.

4. The Bureau of Land Management, in consultation with the State Historic Preservation Officer, will request a determination of eligibility from the Secretary of Interior for all sites which appear to meet the criteria for listing on the National Register of Historic Places. (35CFR 800.4 (a) (2), and 800.10).

Presently, sixteen prehistoric sites have been determined eligible for listing on the National Register. These are: 24BHL583, 1589, 1591, 1593, 1595, 1597, 1602, 1614, 1610, 1606, 1609, 1045, 1618, 1046, 1619 and 1052. Five sites, 24BHL044, 1058, 1605, 1598, and 1584 require further testing to determine if criteria are met. Site 24BHL617 has been determined ineligible.

5. The BLM, in consultation with the State Historic Preservation Officer, will determine the effect of the proposed Central Field Mine Plan as described in Item 2 above on all cultural resources eligible for listing on the National Register of Historic Places (36CFR800.8). If effect is established, the criteria for adverse effect will be applied (36CFR800.9). The finding will be submitted to the Executive Director of the Advisory Council on Historic Preservation along with a preliminary case report (36CFR800.4 (2) (e) & (f)).
6. If the effect is found to be adverse, the responsible federal agency will direct NERCO to prepare a research design for the mitigation of effect by a data recovery program or the avoidance of effect. This mitigation avoidance design plan may be submitted to various concerned state and federal agencies, and will be submitted to the State Historic Preservation Officer and the Executive director of the Advisory Council on Historic Preservation as a part of the required consultation process (36CFR800.5)
7. The BLM, State Historic Preservation Officer, and the Advisory Council on Historic Preservation will review the preliminary case report, the mitigation design and avoidance plan to consider alternatives of mitigation and avoidance. The three parties' decision will be in the form of a Memorandum of Agreement (36CFR800.5 and 800.6).

The above steps must be completed prior to the issuance of a mining permit or the implementation of any mitigation plan.

XI-78

Mr. Edwin Zaidlicz

July 12, 1978

8. The responsible federal agency may authorize NERCO to begin any mitigation approved in the Memorandum of Agreement. Mitigation by data recovery may be completed in stages so as to permit the timely execution of any approved project. All parties signatory to the Memorandum of Agreement must agree in writing that all mitigation in any particular area is complete prior to the disturbance of that area.
9. A final professional report on all inventories, mitigation design and plan, and data recovery will be submitted to this office and other appropriate state and federal agencies for review and comment.

The items discussed above were addressed during a meeting held in Helena on July 12, 1978. Those in attendance (list attached) included representatives of the U. S. Geological Survey, the Bureau of Land Management, the Department of State Lands, the State Historic Preservation Office, and Northern Energy Resources Company. All parties concurred with the procedures as outlined above.

Now, for a few general observations. We must remain objective in our quest for identification of project impacts to cultural resources. It is therefore, critical that an intensive inventory and testing be conducted prior to the implementation of any mitigation plan on known sites. Mitigation closes the door to any other alternatives; and, therefore, it is in violation with the purposes of the National and the Montana Environmental Policy Acts to begin excavation prior to the completion of the review process.

The identification of all impacts to cultural resources may change the direction of presently conceived mitigation plans. A well executed mitigation avoidance design plan should be applicable to all sites in this area in its overall research objections, not just previously recorded sites. This primary document can then specify exactly what form mitigation will take at each particular site. It can be amended as work progresses, if necessary, to meet changes in research needs. I see no need for two separate mitigation documents for recorded and yet to be identified sites.

If previously recorded sites are mitigated prior to the completion of the total inventory and implementation of the Advisory Council's procedures on all eligible and adversely effected sites, it may lead to confusion as to which areas have compliance, and where project implementation can begin.

Thank you for consulting with me in your planning stages. I would appreciate being kept up to date on your study by receiving any progress reports or interim reports that you may require. I would also be interested in reviewing the contract for the cultural resource inventory and testing, and the contractor's proposal.

Sincerely,

Ken Korte

State Historic Preservation Officer

KK:EV:rgb

cc: (see attached list)

8111 - CULTURAL RESOURCE INVENTORY
AND EVALUATION (UPLAND)

.14 Class III - Intensive Field Inventory.

A. Objectives. The objective of a Class III inventory is to identify and record, from surface and exposed profile indications, all cultural resource sites within a specified and defined area. The Class III inventory results in a total inventory of cultural resource sites observable within a specified area. Upon completion of Class III inventories within a specified area, no further cultural resource inventory work will usually be needed. However, further cultural resource data studies may be carried out, as necessary. (See .14C4.)

B. Methodology. Define the area of the inventory accurately and clearly. Actual ground coverage results in the identification and recordation of all cultural resource sites observable from surface and exposed profile indications. Use the following guidelines:

1. Review the existing cultural resource site records prior to beginning actual ground coverage. Identify all recorded cultural resource sites within the area to be inventoried.

2. Locate, on the ground, the boundaries of the inventory area prior to beginning the inventory. Use corner markers, benchmarks, topographic maps, aerial photographs (where available), and other locational features and aids. This ensures ground control and proper location of cultural resource sites.

3. Cover the area to be inventoried on foot, utilizing adjacent sweeps. Spacing between crew members should not exceed 30 meters. However, spacing may be varied according to terrain, obtrusiveness, visibility, or other factors provided a valid rationale for intensity of coverage is presented. In all cases, coverage should be thorough, and continuity between sweeps must be maintained.

4. Record each cultural resource site identified (see .3).

C. Report Content and Format. For all Class III inventories, prepare a report commensurate with the project's size and the quality and quantity of cultural resources present. For small-scale projects involving minimal surface disturbance, or small project areas having no cultural resources, a brief summary document, with appropriate maps and site forms, which addresses the general categories outlined below, may be all that is necessary. For large-scale projects involving extensive surface disturbance and numerous cultural resources, a detailed report with extensive documentation may be required. All Class III reports should provide an appropriate level of data for the following categories of information:

ATTACHMENT: 2

ARCHAEOLOGICAL CLEARANCE MEETING
 SPRING CREEK PROJECT - HELENA, MONTANA
 JULY 12, 1978

<u>NAME</u>	<u>TITLE</u>	<u>PHONE</u>
Mike Eidlin	NERCO	503-243-4892
Dee C. Taylor	Anthropology, Univ. of M.	406-243-5921
Alan Carmichael	Anthropology, U. of M.	406-243-2693
Tom E. Roll	Anthropology, M.S.U. SHPO Consultant	406-994-4201
Edrie Vinson	State Historian, Preserva- tion Office	406-449-2694
Sandi Johnson	DSL - Coordinator	406-449-2074
Ralph Driear	DSL - Environmental Admin.	406-449-2074
Jon M. White	U.S.G.S. OAMS, Billings	Com. 657-6181 FTS 585-6181
Stephen F. Lintner	U.S.G.S. Reston, VA	Com. (703) 860-6464 FTS 928-6464
Craig L. Howard	DSL - Coordinator	406-449-2074
Mike Arne	NERCO	503-243-4886
Bob Bennett	BLM, Miles City	232-4331
Jim Murkin	BLM, Miles City	232-4331
Margie Taylor	BLM, MT State Office	FTS 585-6474
Jerry Clark	BLM, Miles City	232-4331
Glenn Malmberg	U S.G.S., Billings	Com. 657-6678 FTS 585-6678
David Schleicher	U.S.G.S., Denver	Com. (303) 234-3960 FTS 234-3960

Appendix O.

The VRM rating system evaluates scenic quality, visual sensitivity levels and visual zones.

- 1) Scenery quality ratings are based on the presence of landforms, color, water, vegetation, uniqueness, and intrusions. After rating, the areas are grouped into Class A - 15-24 (Excellent), Class B - 10-14 (Good), or Class C - 1-9 (Average).
- 2) Visual sensitivity levels are an index (high, medium, or low) of the relative importance of the visual resource. In this case, the only criteria used was numbers of viewers.
- 3) Visual zones are areas that can be seen as foreground-middleground (3-5 miles from viewpoint), background (5-15 miles from viewpoint), or seldom seen (areas with little or no visibility or beyond the background zones.)

Landscape character elements (form, line, color, and texture) are described because they are the basic factors used to measure changes (or impacts) resulting from the proposed action.

- Form - The mass or shape of an object. It is most strongly expressed in the shape of the land surface, usually the result of some type of erosion, but may also be reflected on the shape of the openings, changes in vegetation, or in the structures placed on the land.
- Line - Abrupt contrast in form, texture, or color. Lines may be found as ridges, skylines, structures, changes in vegetative types, or individual trees and branches.
- Color - Usually most prominent in the vegetation but may be expressed in the soil, rock, water, etc., and may vary with the time of day, year and the weather.
- Texture- Result of the size, shape, and placement of parts, their uniformity, and the distance from which they are being observed. Texture is usually the result of the vegetation or vegetative patterns on the landscape. Texture may also be the result of the erosive patterns in rocks or soil.

These factors are combined to determine Visual Management classes for which suggested management objectives are prescribed (see Chart II___). These classes describe the degree of visual alteration that is acceptable according to Bureau of Land Management standards within the characteristic landscape. Class I provides the greatest amount

of protection while Class IV allows for modification of the landscape character.

Class I (Preservation). This class provides primarily for natural ecological changes only. It is applied to primitive areas, some natural areas, and other similar situations where management activities are to be restricted.

Class II (Retention of the landscape character). Changes in any of the basic elements (form, line, color, or texture) caused by an activity should not be evident in the characteristic landscape.

Class III (Partial retention of the landscape character). Changes in any of the basic elements (form, line, color, or texture) caused by a management activity may be evident in the characteristic landscape. However, the changes should remain subordinate to the visual strength of the existing character.

Class IV (Modification of the landscape character). Changes may subordinate the original composition and character, but must reflect what could be a natural occurrence within the characteristic landscape.

Class V (Rehabilitation of enhancement of the landscape). Applies to areas where the naturalistic character has been disturbed to a point where rehabilitation is needed to bring it back into character with the surrounding countryside. This class would apply to areas identified in the scenery evaluation where the quality class has been reduced because of unacceptable intrusions. It should be considered an interim short term classification until one of the other objectives can be reached through rehabilitation or enhancement. The desired visual quality objective should be identified.

Detecting contrast (or impacts) in the basic elements varies on a scale from 4 (form) to 1 (texture). Assigning values that indicate degree of contrast (3 for strong, 2 for moderate, and 1 for weak) allows a direct multiplier to be set up which will indicate the strength of the contrast. A score of 1-10 for each feature indicates that the contrast can be seen but does not attract attention; 11-20 attracts attention and begins to dominate the landscape; 21-30 demands attention and will not be overlooked. The total score is not as significant as the score for a single feature. The contrast ratings for the proposed mine are summarized in Table 3-1 & 2.

Appendix Q

STATE OF MONTANA



DEPARTMENT OF STATE LANDS

MAILING ADDRESS: CAPITOL STATION
OFFICE: 1625 11TH AVENUE

HELENA 59601

(406) 449-2074

STATE BOARD OF
AND COMMISSIONERS

THOMAS L. JUDGE
GOVERNOR

GEORGIA RICE
T. OF PUBLIC INSTRUCTION

FRANK MURRAY
SECRETARY OF STATE

MIKE GREELY
ATTORNEY GENERAL

V. "SONNY" OMHOLT
AUDITOR

RETURN RECEIPT REQUESTED

Certified Mail No. _____

January 12, 1978

NERCo

P.O. Box 8451

Portland, OR 97207

Attention: Mike Arne

Re: Application for Permit
#00050 for Spring Creek Project

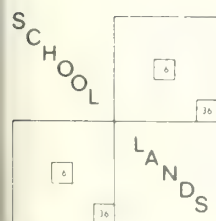
Dear Mr. Arne,

The Department of State Lands has reviewed your application for permit #00050 received 8/1/77 and as revised by letters of 8/4/77, 8/9/77, 8/11/77, 8/25/77, 9/22/77, 10/3/77, 10/17/77, 11/10/77, 11/22/77, 11/28/77, 12/1/77, 12/2/77, 12/22/77, 12/22/77 and 12/27/77.

The application is deemed not complete at this time. Due to numerous revisions and the complexity of the application format further correspondence will be forthcoming as information is received from expertise concerning specific problems. As explained in my letter of 12/16/77, please follow your present system of complete replacement of pages and/or plates when making revisions or corrections.

NERCo's application must comply with the initial federal regulatory program as outlined in the final interim regulations dated December 13, 1977. Sections 715 and 716 must be compiled with. The Department of State Lands has not made a complete analysis of your application regarding compliance with these sections as clear copies of the final regulations have not been received to date. A letter will be forthcoming concerning compliance with the federal act.

The following general comments should be addressed with a positive commitment in the narrative of your application. Be as specific as possible in your response.



MINING



RECLAMATION

1. Materials which are not conducive to revegetation techniques, establishment, and growth shall not be left on the top or within eight feet of the top of regraded spoils or at the surface of any other affected areas. The department may require that problem materials be placed at a greater depth.
2. Box cut spoils or portions thereof, shall be hauled to the final cut if:
 - a) excessively large areas of the mine perimeter will be disturbed by proposed methods for highwall reduction or regrading of box cut spoils, or
 - b) material shortages in the area of the final highwall or spoil excesses in the area of the box cut are likely to preclude effective recontouring.
3. The department may require terracing to conserve moisture and control water erosion on all graded slopes during the process of current grading.
4. If the operation involves stripping and augering, the augering shall follow the stripping by not more than 60 days and final grading and backfilling shall follow the augering by not more than 15 days, but in no instance shall an area be left ungraded more than 1,500 feet behind the augering.
5. All backfilling and grading shall be completed within 90 days after the department has determined that the operation is completed or that a prolonged suspension of work in the area will occur.
6. In all cases the final pit shall be backfilled so as to cover all exposed coal seams with at least 4 feet of non-toxic fill material.
7. All mining activities, including highwall reduction, and related reclamation shall cease 100 feet from a property line, permanent structure, unmineable, steep, or precipitous terrain, or any area determined by the department to be of unique scenic, historical, cultural, or other unique value. If special values or problems are encountered by the department, it may modify buffer zone requirements.
8. The transition from undisturbed ground shall be blended with cut or fill to provide a smooth transition in topography.
9. Haul roads through permitted areas shall be allowed providing that their presence does not delay or prevent recontouring or revegetation on immediately adjacent spoils.

10. The department may require that access roads be graded, constructed, and maintained in accordance with the following requirements:
 - a) no sustained grade shall exceed 8%,
 - b) the maximum pitch grade shall not exceed 12% or 300 feet,
 - c) there shall be no more than 300 feet of maximum pitch grade for each 1,000 feet,
 - d) the grade on switchback curves shall be reduced to less than the approach grade and shall not be greater than 10%,
 - e) cut slopes shall not be more than 2:1 in soils or 1/2:1 in rock,
 - f) all grades referred to shall be subject to a tolerance of 2% of measurement. Linear measurements shall be subject to a tolerance of 10% of measurement.
 - g) additional requirements may be imposed by the department if special drainage or steep terrain problems are likely to be encountered.
11. Drainage ditches shall be constructed on both sides of the through-cut, and the inside shoulder of a cut-fill section, with ditch relief cross drains being spaced according to grade. Water shall be intercepted before reaching a switchback or large fill, and shall be drained off or released below the fill. Drainage structures shall be constructed in order to cross a stream channel, and shall not affect the flow or sediment load of the stream.
12. All cut and fill slopes resulting from construction of access roads, railroad loop, or haul roads outside of the area to be mined shall be stabilized, and revegetated the first seasonal opportunity.
13. Upon abandonment of any road or railroad loop, the area shall be conditioned and seeded and adequate measures taken to prevent erosion by means of culverts, water bars, or other devices. Such devices shall be abandoned in accordance with all provisions of Chapter 325, Session Laws of Montana, 1973, and MAC 26-2.10 (10)S-10330 and MAC 26.210(10)-S10340 of the Rules and Regulations adopted pursuant thereto. Upon completion of mining and reclamation activities all roads shall be closed and reclaimed unless the landowner requests in writing and the department concurs that certain roads of specified portions thereof are to be left open for future use.
14. Please address all points in the Rules and Regulations regarding blasting, in narrative form and agree to comply with every requirement.

15. Stockpiles of salvaged topsoil shall be located in an area where they will not be disturbed by ongoing mining operations and will not be lost to wind erosion or surface runoff. All unnecessary compactions and contamination of the stockpiles shall be eliminated and once stockpiled the topsoil shall not be rehandled until replaced on regraded disturbances.
16. In the case of abandoned roads, the roadbeds shall be ripped, disced, or otherwise conditioned before topsoil is replaced the department may prescribe additional alternate conditioning methods for the reclamation of abandoned roadbeds.
17. If necessary, redistributed topsoil shall be reconditioned by discing, ripping or other appropriate methods. Gypsum, lime, fertilizer, or other amendments may be added in accordance with MAC 26-2.10(10)S-10350, and/or as stated in the approved reclamation plan.
18. The operator shall take all measures necessary to assure the stability of topsoil on graded spoil slopes.
19. Any application for permit or accompanying reclamation plan which for any reason proposes to use materials other than or along with topsoil for final surfacing of spoil or other disturbances shall document problems of topsoil quantity or quality. The application or plan must also show that the topsoil substitute proposed:
 - a) will not contribute to or cause pollution of surface or underground waters.
 - b) will support a diverse cover of predominately native perennial species equivalent to that existing on the site prior to any mining related disturbance.
20. The assignment of BLM Coal Lease Montana - 069782 from PP&L to Spring Creek Coal Company must be completed before a permit will be issued.
21. The proof of publication section, described on pages 12 and 13 of volume 1 of the application for surface mining permit, is not acceptable as the actual "proof of publication" notice from the newspaper must be received by this Department.
22. Subsidence potential after mining may pose serious problems with respect to; 1) reestablished stream gradients which will be quite gradual, and 2) to the separation of the 2 forks of Spring Creek which appear to have very little in the way of a topographic barrier between them after mining. The problem of subsidence has not been addressed by Spring Creek Coal Company in its application.

23. Page 21 the last two paragraphs. There is a 44 million ton difference between the strippable and the recoverable figures. Where is all of this coal (15%) being lost?
24. On page 33 of the application it is stated that 4 feet of topsoil will be placed back into the reestablished floodplains of Spring Creek. The questions and comments that arise are:
1) Is 4 feet adequate to reestablish an alluvial aquifer? 2) The topsoil to be placed back into the channels should probably be the alluvium that was there in the first place. This would mean discrete salvage of the texture of soils to place back into the channels is required in any attempt to reestablish and stabilize an alluvial situation. 3) The channel slopes are proposed to be at a slope of 2:1. Although those would be very short slopes, the change in slope from the rest of the regraded mine area into the channels is quite abrupt. We may have trouble stabilizing them.
25. On page 32 of the application specifications of the settling ponds are given. One thing that was not specifically mentioned by the company was the placement of clinker at the discharge points of the outlet pipes which are connected to the decanting towers. This should be done.
26. Page 39 - any modification of the grain drill making it more suitable for reclamation purposes must be discussed. Superior results have been obtained by Decker utilizing "Brillion" cultipacker.
27. Page 42 - The cover crop to be used should be specified and seeding rates included. If millet is to be used the suitability of millet should be referenced.
28. Page 45 - while mulching prior to seeding to prevent wind erosion is desirable, drill seeding could effectively disrupt the effectiveness of the mulch. Since there is a limit to the organic material which can be decomposed by soil microorganisms, only one mulch application is advisable. It would seem logical to apply mulch after seeding. The mulch would then prevent erosion of the soil covering the seed, and maintain soil moisture, while adding organic matter to the soil. The planting sequence should be reworked to obtain one mulch application after seeding.
29. In the analysis of regraded and retopsoiled spoils areas referred to on page 45, analysis of NH_4^+ -N should be added to topsoil analysis; the analyses of gypsum requirement can be deleted from the spoils analysis. At least part of the fertilizer should be applied at the time of seeding, not exclusively during the second growing season as the company proposes.

30. On page 54, Spring Creek Coal Company has indicated that it may use a chemical dust suppressant. Prior to the use of such a material, the company should inform us as to what the chemical is, what its composition is, and should obtain departmental approval. Commit to this procedure in your application.
31. Page 82 - The representative characteristics (BTU's, ash, sulphur, etc.) of the Canyon seam are not presented. Federal 211 Regs ask for this information.
32. On page 85, and 86, the company lists provisions of 30 CFR 211 regulations which it must comply with under the cooperative agreement between the Department of State Lands and the Feds. If the company desires variances from these requirements (which relate to the sampling of overburden) it should obtain a letter from the U.S. Geological Survey authorizing such variances. A copy of this letter should be sent to us.
33. The letter referenced under III, B page 86 is not acceptable as the letter specifically addresses the question of an "exploration permit", not a mining permit.
34. On page 111, under (ii), how will Spring Creek Coal Company go about "limiting the size, timing, and frequency blasts as determined by the physical conditions of the site?" This is an important consideration from the standpoint of air quality impacts, since blasting can create substantial dust problems. In addition, blasting can have an effect on aquifers outside the permit boundary.
35. The Department of State Lands is adopting a policy of 5:1 highwalls as the maximum allowable slope on reclaimed area. Problems with stabilization of 3:1 slopes have necessitated this change. On page 112 no slopes should be steeper than 5:1.
36. On page 113 in the response of Spring Creek Coal Company to "F", the words "whenever practicable" should be deleted.
36. Page 114 - The next to the last paragraph should read ". . . prepare the soil and plant such legumes, grasses, shrubs, and trees . . ."

The following comments are specific to vegetation.

There are two remaining inadequacies in the baseline vegetation work which must be addressed.

1. The calculation of the range condition and carrying capacity is presently unacceptable. The Department of State Lands has talked to Paul Higgins about this problem, and he has assured the Department that a new section is forth coming.
2. If any of the areas described as weed community are presently being managed agriculturally (as pasture improved range or hay field which would qualify under the federal law) these areas should be indicated. If possible an agricultural history should be presented for the cultivated areas. Period of cultivation, approximate date of abandonment, crops raised, etc.

Page 48, Table 5 - There are two overriding problems with all of the mixtures proposed in the Spring Creek application:

1. The mixtures are too specific. In attempting to design mixtures for specific sites they have in many cases designed them for specific soils. What the soils will be after mining is an unknown. While specific mixtures should be designed for stream courses and highwall reductions. A "broad brush" type mixture would be better suited for the majority of the area. This means a mixture with sufficient diversity to develop communities on the different microsites encountered on the regraded area.
2. The mixtures contain no legumes. Legumes would help build the soil after mining.

Page 48, Table 5 Area #1 - The mixture is essentially acceptable, however more shrubs, in particular skunkbush sumac should be added.

Page 48, Table 5 Area #2 - More grasses should be added. Antelope bitterbrush is not found in this area and should be relegated to an experimental status. The mixture should include shrubs such as rose, snowberry, and possibly chokecherry (these species would likely have to be planted as seedlings or transplants).

Page 49, Table 5 Area #3 - This mixture lacks diversity, and while it may be suited for floodplains, is not suited for stream channels. A more diverse mixture should be devised for the floodplain, or a general purpose mixture should be used. The stream channel should include strongly rhizomatous species and mesic species. Basin wildrye occurred there naturally and should be included. Other trees and shrubs should be included for the sites too mesic for silver sagebrush. An effort should be made to replace the cottonwoods.

Page 49, and 50. Table 5 Areas #4, 5, and 6. The mixtures for areas 4, 5, and 6 should be combined for a single "broad brush" mixture. The area 4 mixture appears to be designed for heavy textured soils. The cool season, warm season breakdown for areas 5 and 6 are not valid. Spring Creek should strive to find a diverse mixture which would establish a suitable cover for the whole area. Modifications should then be made for specific sites. The idea of selected corridors for wildlife is unacceptable. Wildlife habitat should be spread throughout the area.

Page 51 - paragraph (7) Spring Creek should specify mulching of all disturbed areas, except where cover crops are established as approved by the Department pursuant to the federal rules.

Previous reclamation experiences have indicated little success with establishing species such as Ponderosa Pine, skunkbush sumac, and other tree and shrub species by seed. Spring Creek should commit to using seedlings and/or transplants to reestablish tree and shrub species.

The problems of habitat reestablishment of tree and shrub species on reclaimed land will probably be the greatest reclamation problem to be faced. Intensive efforts in planning are needed now to provide suitable techniques seed sources to solve the problem. The idea of utilizing a tree spade to transplant trees and shrubs from areas to be disturbed shows great promise and should be investigated. Similarly the concept of sodding dense rooted grass species from bottom lands and using the mat to stabilize recently reclaimed potential problem areas should be seriously considered.

During the review of the wildlife baseline study, prepared by VTN, we have noted the following deficiencies which require greater elaboration to adequately assess the wildlife portion of the permit application pursuant to 50-1042 RCM 1947 and 26-2.10(10)-S10300(c) A.R.M.

1. There was no listing of the biologists participating in the study. Such a listing and their qualifications are necessary to assess Sections 50-1042 RCM 1947 and 26-2.10(10)-S10300(c) A.R.M.
2. The description of the wildlife habitat types is in apparent conflict with the results of the vegetation survey. Of particular concern is the breakdown of the sagebrush vs. sagebrush/grassland types. The sagebrush type is composed of one vegetation community while the sagebrush/grassland type is composed of five vegetation communities. All of the vegetation communities encompassed by these two wildlife habitat types are physiognomically similar, thereby, skewing the relative importance of the sagebrush/grassland type. Further, the incorporation of shrub species other than sagebrush (eg. Rhus trilobata) into the sagebrush/grassland habitat obscures the importance of such shrubs to wildlife (Section 50-1042(2)(a) RCM 1947).

3. The Chiroptera need more work. The bat collections were very random. Collections and species identifications should include sex of each species, condition of the species (i.e. lactating female, etc.), date of the collection and location of the collection. Attention should be focused on the Montana Department of Fish and Games listing of species of special interest (Section 50-1042(2)(c) RCM 1947 and 26-2.10(10)S10300(c)(i) A.R.M.).

4. The Peregrine falcon is an endangered species and was observed on the study area. Also, VTN made reference to the spotted-bat, a threatened species. More discussion is needed on this species (26-2.10(10)S10300(c)(i) A.R.M.).

5. The map showing the active and inactive raptor nesting locations should be revised to include the locations of the prairie falcon nests referenced in the baseline text (26-2.10(20)-S10300(c)(i) A.R.M.).

6. The method of calculating small mammal densities was not referenced and should be. Also, the dates and times that aerial flights were made to estimate ungulate population densities should be submitted (26-2.10(10)-S10300(c)(ii) A.R.M.).

7. Seasonal use of the study area by wildlife, particularly mule deer and pronghorn antelope, can not be interpreted from the maps. Maps should be revised to indicate season of use of the "major use areas" delineated on the ungulate maps. The discussion in the text should shed further light on this subject and discuss where the deer and pronghorn migrating into the area were previously distributed.

A wildlife habitat type map should be prepared and accompanied by mylar overlays of monthly sightings of mule deer, pronghorn antelope, and the gallinaceous birds. Such maps would be most beneficial if they were produced at a scale of 1"-1000'.

There was no discussion concerning fawning areas or nesting and brooding areas.

Such information is necessary to evaluate sections 50-1042(2)(c) RCM 1947 and 26-2.10(10)-S10300(c)(iii) A.R.M.

Generally the wildlife section lacked discussion and recommendations of the biologists who worked on the project. Probable impacts of the various phases of the mining operation should be discussed in detail by the biologist conducting the study. The project biologists should also discuss specific reclamation techniques to be incorporated into the reclamation plan to provide successful reclamation regarding wildlife species reestablishment.

The project biologists should give complete summaries of data and their interpretations. The wildlife data shows the Spring Creek may be a wintering ground for sage grouse, antelope and mule deer. Complete discussions of winter concentration areas are required. The presence of winter concentration areas may pose a special problem as the Department of State Lands cannot approve a permit containing items found under Section 9, (2)(a)(b)(c). The presence of winter concentration areas may involve considerations of items a, b and c. This problem should be directly addressed by Spring Creek.

Another problem to be addressed will be reclamation to provide a similar habitat which existed before mining for wildlife species. Under section 12 (a) in the act, the reclaimed vegetative cover must be capable of "feeding and withstanding grazing pressure from a quantity and mixture of wildlife and livestock at least comparable to that which the land could have sustained prior to the operation."

The presence of dancing and strutting ground as well as winter concentration areas may require further indepth radio telemetry to discern animal habitat needs and seasonal migration routes.

The presence of various raptor nests on the Spring Creek site will probably involve obtaining special permits under the Migrator Bird Treaty Act. Numerous other birds are also covered under this act.

The following discussion considers the adequacy of hydrological information submitted in the Spring Creek Application.

1. As specified under 26-2.16(10)S10300(2)(e)(ii), "The report shall include . . . a description of alternative water supplies to be undisturbed by mining that could be developed to replace water supplies diminished in quality or quantity by mining activities." NERCo has not supplied this information to date.

In a letter to Rick Kent dated 6-1-77 the following information was requested:

"State personnel expressed a need to monitor the next lower aquifer zone below the coal to observe changes that may take place in this zone as a result of mining and to identify an alternate water supply for the impacted area. NERCo agreed to run a pump test on well number 372 to determine if there is a sufficient quantity of water to serve as an aquifer and to sample the quality of water as well. Consideration should be given to the potential for this zone to mix with the lower quality waters that will occur at the base of the pit after mining. The state is not optimistic that the interburden between the Anderson Dietz and the Canyon can be proven an aquifer, nor that it will be hydrologically isolated enough from lower quality, post-mining ground waters to allow it to be used as a quality alternate water supply."

Based on the information from this study a final evaluation would be made of the alternate water supply, that would be unaffected by mining, to be used to support the post-mining land use. There is a possibility that additional data will be necessary to adequately determine what zone will be hydrologically separated from mining related impacts and yet provide a sufficient quantity of water for the intended land use.

In addition, a letter written to Rick Kent on 7-577 requested that; additional monitor wells be installed, single well recovery tests be conducted, water quality samples be collected and water levels be recorded. This material has not been received.

2. The Department does not agree with NERCo's plan to divert drainage from the scoria pit to a drainage south of the original direction of flow. The coulee currently receiving drainage from the area should receive the post-mining runoff from the area and the settling facility should be located in the same coulee.

The final contours for the scoria pit should also be more smoothly blended with the existing topography.

3. NERCo predicts that 106,000 gallons per day will be intercepted in the pit. The Department would like to know how this number was developed.
4. Tributary drainages to Spring Creek and South Fork Spring Creek that are peripheral to the mine do not enter the reclamation area at an acceptable grade.
 - a) Coulees entering the Spring Creek mine from the south bluff area drop too abruptly over the highwall reduction area.
 - b) The tributary to South Fork Spring Creek on the west end of the mine is too steep just after entering the lease boundary.
 - c) The major tributary to Spring Creek at the west end of the lease boundary drops too abruptly into the reclaimed area.
5. Concerning the major drainages of South Fork Spring Creek and Spring Creek.
 - a) The post-mining recontoured surface map does not clearly show how reconstructed Spring Creek will be separated from the original Spring Creek channel in Section 24 BCD.

- b) The gradients of both Spring Creek and South Fork reconstruction are sporadic.
 - 1. The gradient of South Fork is too steep where the drainage enters the lease boundary and from that point the gradient randomly flattens and steepens along the stream passage through the mine area.
 - 2. Similarly the gradient of Spring Creek randomly flattens and steepens along the course through the disturbance.
- c) The Department would like the rationale used by NERCo to arrive at the meander frequency, amplitude and radius of curvature for the reclaimed South Fork and Spring Creek channels.
- d) The Department does not agree with the Manning's N of 0.045 selected for the reclaimed channels of Spring Creek and South Fork. According to the E.P.A. publication "Erosion and Sediment Control Surface Mining in the Eastern U.S." vol. 2 p. 39, for a natural channel not completely lined with vegetation, a Manning's N of .025 is appropriate. NERCo can not assume that a dense mat of grasses can be established that would allow design according to the specifications for a grassed waterway. The E.P.A. publication continues, for natural channels not completely lined with vegetation in a clay loam a maximum non-erodable velocity of 4.0 feet per second is allowable. Although the objective is not to design a non-erodable channel, but rather a channel as stable as the natural drainage, a velocity well over 4 feet per second, can be expected when the correct N value is used. Such high velocities are critical. The Department would compromise on a velocity of 5 feet per second maximum velocity for the predicted 100 year storm.
- e) The statement on page 27 of the Mining Permit Application, paragraph 1 that, "The peak flows are the result of rain-storm runoff." is not correct. On page 118 of the Mining Permit Application the data indicate the maximum storm on record for Spring Creek occurred February 14, 1971. A check of rainfall records indicated that no significant rainfall event occurred on that date. Therefore it is safe to conclude that the runoff event was a result of snow melt and possibly influenced by a light rain or frozen soils. The Department therefore cautions NERCo that floods can be expected at times other than the spring thunderstorm period.

- f) New Federal Regulations recently published pursuant to the Surface Mining Control and Reclamation Act of 1977 state that, (715.15(J) Mining operations conducted in or adjacent to alluvial valley floors shall be planned . . . to preserve the essential hydrologic functions." The recognized subirrigated area on South Fork Spring Creek appears to fit under these provisions and should be addressed accordingly.
- g) The Department does not approve of the proposed excavation impoundments on Spring Creek and South Fork for the following reasons.
 - 1. In order to evaluate the stability of the reclaimed channels a free flowing waterway must be maintained.
 - 2. The excavation will cause a locally steepened portion in the stream gradient which could initiate a head cutting sequence.
 - 3. Impoundments of this nature would induce unwanted leaching of spoil materials which would continue to lower groundwater quality.

In summary the Department would like to see all drainages blended with the reclamation topography with a smooth concave longitudinal profile. Flood predictions should be calculated for all drainages under the conditions of a 100 year storm and velocities should be calculated using the appropriate N of .03 which is widely used and accepted in the state. A maximum velocity of 5 feet per second should be reached during the 100 year storm.

- 6. The Department has the following comments on the diversion ditches associated with the Spring Creek Mine:
 - a) Under the conditions of a 50 year flood, the maximum design of the ditches, velocities are excessively high. The upper reaches for both diversions develop velocities over 7 feet per second which will surely scour out the scoria lining. A velocity of 5 feet per second should be the maximum velocity under the maximum design conditions. Velocities on the lower cascading stretches appear excessive also. On Spring Creek a velocity of 17 feet per second exists under the conditions of a 50 year flood. Although these ditches are in scoria it is doubtful if the fractured clinker could withstand such velocities. The Department has observed severe erosion in scoria bedrock and suggests that velocities be kept below 6 feet per second.

- b) The concept of using two different gradients along the ditch demands that additional channel protection is needed where the channel breaks into the steeper gradient in order to prevent headcutting. Similarly the channel reach below the cascading portion must be protected with an apron in order to prevent accelerated erosion in the natural channel.
 - c) The Manning's N selected for the scoria channel is somewhat suspect. In Chow's book on Open Channel Hydraulics (1959), p. 120 a canal with large-cobblestone bed is assigned a N of .03. The E.P.A. Erosion and Sediment Control publication vol. 2, p. 42, calls for a lined channel with a median riprap size of approximately 15 inches for an N of .04.. Due to the brittle fracturing nature of scoria it is doubtful that a 15 inch median riprap size can be achieved. The Department therefore asks that NERCo reassess the design of the diversion ditches using an N of .03.
- 7. The Department requests the geologic source of water from wells intended for mine personnel use.
- 8. The reclamation of the building area, railroad loop and bank-roads outside the lease boundary should be specified in narrative and depicted on the post-mining contour map.
- 9. Impounding structures should be excavated to remove accumulated sediments when they reach 5 percent of the storage volume of the structure as recommended by the Bureau of Reclamation in Design of Small Dams. The 5 percent volume should be staked in the field so personnel can readily observe when dredging is required.
- 10. The Department requests that NERCo establish flumes on the ditch or stream reaches that will receive pumped waters from the pit and that an accurate record be kept of pit water used in the mine. The purpose of this request is to check predictions of water interception in the pit. Hopefully if good records are kept, prediction techniques can gradually be improved.
- 11. The Department requests that NERCo plan the water supply for the post-mining land use and commit to drilling a specified number of wells. The well location, power source, geologic source, water quality and pumping rate should be given with information relating the well location to the post-mining management scheme.

12. Water quality analyses for the surface water is largely unacceptable. The difference between cation anion balance should not exceed 5 percent. This information will have to be recollected.
13. The Department requests that NERCo respond to the enclosed comments provided by Mr. Fred Shewman of the State's Water Quality Bureau.

In reviewing the archaeological baseline report submitted by NERCo, some deficiencies have been noted. These deficiencies were discussed with representatives of NERCo during a meeting held in Sheridan on October 15, 1977. In view of the complexity of the archaeological situation in the Spring Creek area, several years may be required to accomplish all of the work necessary to adequately address the archaeological resources in this area. A complete application could be attained in the near future, however, if certain criteria are met. The following is a listing of those critieria which were previously discussed with NERCo.

1. Complete an intensive surface survey of the following tracts using the Fox (1977) research desing:

S $\frac{1}{2}$, NW $\frac{1}{4}$, Sec. 23, T. 8 S., R. 39 E.
 SE $\frac{1}{4}$ NE $\frac{1}{4}$, Sec. 22, T. 8 S., R. 39 E.
 S $\frac{1}{2}$ N $\frac{1}{2}$, Sec. 27, T. 8 S., R. 39 E.
 SE $\frac{1}{4}$, Sec. 27, T. 8 S., R. 39 E.
 SW $\frac{1}{4}$, Sec. 26, T. 8 S., R. 39 E.
 W $\frac{1}{2}$ SE $\frac{1}{4}$, Sec. 26, T. 8 S., R. 39 E.

2. Reinventory, test, and mitigate by data recovery the sites recorded by Lahren (1977) using the Fox (1977) research design. Data recovery at this stage should be confined to controlled surface collection. Sites requiring excavation as a mitigating measure should be treated under Step 5.
3. Prepare a research design for the data recovery program on all the sites recommended for the National Register of Historic Places in the Fox report (1977). Submit copies of the research design to the Montana Department of State Lands, the Montana State Historic Preservation Officer and the Miles City District of the Bureau of Land Management through the USGS Area Mining Supervisor for review. Upon approval of the research design by these agencies, the BLM will prepare documents to comply with Section 106 of Public Law 89-665 and submit the recommended treatment of the National Register potential sites for Advisory Council Comment.

4. Initiate a program to discover possible buried cultural deposits where no surface cultural material is visible. In alluvial areas near drainage bottom and on some lower terraces, backhoe trenching or other tests will be undertaken to search for buried cultural sites. The cultural resource contractor may use a probability sampling model or other approach to do the testing but, techniques will be made explicit in reports. If these tests yield high site densities, the program may be expanded as recommended by the contracting cultural resource personnel.
5. As a separate part of the data recovery proposal submitted in Step 3 or as another document, prepare a research design for sites requiring excavation found as a result of activities performed in Steps 1, 2, and 4. Submit this document for agency review as outlined in Step 3.
6. Begin data recovery (excavation) of sites addressed in Step 5 when reviewing agencies approve the research design.
7. Begin data recovery of sites addressed in Step 3 when Advisory Council Comment is taken into account by the Montana SHPO and BLM.

These criteria should be immediately applied to those sites contained within the area of the 5-year permit which would suffer surface disturbance. A written agreement should be received indicating that these criteria would also be applied to all other sites encompassed by the life-of-mine disturbance area in advance of such disturbance.

NERCo's contracting cultural resource personnel are responsible for preparing professional monographs which address the results of all survey, testing, and excavation phases of the outlined project. The reports must synthesize all data collected to address hypotheses stated in the designs. The draft reports will be submitted to the agencies outlined in Step 3 for approval. Agencies have 30 days to respond on report adequacy.

The archaeological survey is not complete at this time.

Last fall, Scott Fisher, soil scientist with the State Northern Powder River EIS Team and Clinton Mogen, retired soil scientist with the S.C.S., conducted some field checks of the soils survey work at Spring Creek. Their work raised some serious questions with regard to the adequacy of soils information received as part of the Spring Creek permit application. Generally speaking, their work indicated that many soil types included within various VTN delineations were not described or mapped and that some mapping units needed refinement, redefinition,

or remapping of boundaries. Discussions with Scott Fisher indicate that the level of mapping done on the Spring Creek project do not meet the minimum acreage requirement of our guidelines which Spring Creek Coal Company agreed to do before the soil survey was initiated and which Spring Creek alludes to in the application.

On a more detailed level, two areas of soil represented by Arvada, Bond, and Hydro series were found by Fisher and Mogen but were not mapped or described by VTN. These soils have undesirable physical and chemical properties and are thus to be avoided in salvage operations, and since in at least one of the two areas they make up an area 20-40 acres in size at Spring Creek, this is a serious omission.

Another problem relates to the lack of detailed descriptive analytical information on map unit #2 designated as Alluvial lands, loamy which appears to have some significant accumulations (up to several feet) of suitable topsoil but which was given a salvage depth of only 20" in the application. It would appear that much work is required on this unit in order to adequately delineate the various soils for salvage and to give the operator a reasonable guide in salvage operations. The same considerations probably apply also to map unit #10 - Terrace Edges and Escarpments, loamy, steep and very steep.

Enclosed find Fisher's and Mogen's observations and comments along with our own for response by Spring Creek Coal Company.

Following are my detailed comments on the specific soils information that was provided by Spring Creek Coal Company.

1. In several instances in the descriptions of mapping units, references were made to soil types that were designated as inclusions and which raised questions about whether these inclusions should be mapped. For example, on page 9, under Colbar, silty clay loam, 1% to 4% slopes, the last sentence indicates that in this mapping unit near scoria beds "deep red loams or silt loam soils and Erlan loams of up to 2 acres occur." If this is the case, it appears as if at least the Erlan loams should have been mapped. If the other soils were highly contrasting with the Colbar, they also should have been mapped. Another example occurs on page 11 where, under Corkim loam (1-4% slopes) is stated "some areas of red soils are included." What are these red soils? Are they high contrasting or low contrasting soils compared to Corkim loam? should they have been mapped? Similar additional questions concerning inclusions are found in Erlan slightly slatey loam, 2 to 6% slopes (page 13), Shale outcrop (page 15); Shinler soils, hilly (page 17); Sperlin loam, undulating (page 19); and Sperlin - Wiberg rocky loams, rolling (page 20).

2. What company conducted the analysis of the soil samples?
3. I found 23 soil samples that were given incorrect textural designations based upon the particle size analysis. All but two of these were clay loams. The other two were silty clay loams. Apparently, the computer stuck when it got to clay loams.
4. The metes and bounds locations of the following soil samples did not match their locations on the soils maps: 1, 2, 7, 10, 11, and 12. Samples sites 14 and 17 were not located on the 1" = 400' soils maps nor was site 14 located on the 1" = 1000' map.
5. On page 43 of the application is given salvage depths of the various soil series and mapping units.
 - a) The first problem that is evident with this list is that 4 mapping units are not included: Erlan slightly slaty loam, 2-6% slopes (mapping unit 3), Sperlin - Wiberg loam, undulation (8); Sperlin loam, undulating (13); Shinler - Rock outcrop, very steep (29).
 - b) Another problem involves the use of single soil sampling locations to establish the salvage depths of Colbar silty clay loam, 1-4% slopes (mapping unit 1) in three general areas where it is located. This soil series on the project area tends to be quite saline at variable depths in the C horizon. Thus salvage depths of this unit will have to be based on considerably more sampling.
 - c) On what basis was 96" established as a salvage depth for Corkim loam and Terrace Escarpments?
 - d) The salvage depths of units 6 and 6X (Kimlen - Colbar - Shinler, 5-10% slopes, and Kimlen - Colbar - Shinler, dissected, 5-10% slopes) were based analytically on two samples (10 and 14) of one of the dominant series - Kimlen. This is a very inadequate basis on which to make such a recommendation.
 - d) There is a difference in the salvage depth of Shinler soils, hilly (4") and the Shinler Component of Shinler - Wiberg soils, hilly (10") which I do not understand.
 - e) The salvage depth of Colbar - Kimlen clay loams (1-4% slopes) (mapping unit 11) is based analytically on one sampling of Colbar series (sample number 13) which is hardly adequate for such a widespread unit.

- f) In the case of soil complexes, Spring Creek Coal Company has in some cases estimated topsoil volume based upon a single salvage depth of all series found in the complex. In other cases the complexes are broken down into their component series and salvage depths of each series are listed. What is the reason for these differences?
 - g) Does Spring Creek Coal Company propose to salvage topsoil consistent with their salvage depth estimated on page 43?
 - h) The Travella - Shinler complex is given the mapping symbol 17 in the text but 19 on the soils maps.
6. Spring Creek Coal Company should formulate a two lift salvage operation of topsoiling material. The A and sometimes B horizons should be salvaged separately from underlying C horizons. Characteristics of concern in this regard are more favorable organic matter, biological activity, and nutrient levels and lower lime contents in surface horizons as compared with subsurface horizons. The high Mg: Ca ratios as found in the water saturation extracts in subsurface horizons are also of some concern from a nutritional standpoint. Thus, gross maintenance of the integrity of surface and subsurface topsoiling materials is desirable.
 7. On page 41 of the application are listed the soil criteria by which salvage depths were determined. The cutoff for conductivity was 8.5 mmhos/cm which seems too high to me.
 8. There are numerous errors on the soils maps the most common of which was 2 symbols occurring in the same delineation.

Everything considered, it appears as if the current soils survey information is an inadequate basis on which to evaluate the distribution and nature of the various soil types found at Spring Creek and to formulate an intelligent topsoil salvage plan.

There are substantial potential problems with the overburden that Spring Creek Coal Company needs to specifically address.

1. Substantial salt contents occur in the upper 10-30 feet of overburden. The almost invariable occurrence of this condition in the surface strata raises the question as to whether contamination of surface samples may be involved. Thus the department requests the original driller's logs and any other pertinent information relative to the means by which the holes were drilled and the samples taken. If the salt contents are, in fact, accurate representations of this parameter, the company will have to show how it intends to place the material so that it will not be within 8 feet of the post-mining surface and not in contact with post-mining groundwater.

2. Substantial NO_3^- concentrations also occur in the surface strata of a number of holes. Again, if these are accurate representations of the NO_3^- contents in these strata, Spring Coal Company must show how it will keep this material out of contact with post-mining groundwater.
3. The majority of holes show sodic conditions (measured by both SAR and ESP) in all but the surface strata. How does Spring Creek Coal Company propose to keep this material below 8 feet of the reclaimed surface?
4. Other parameters of concern include the extremely high extractable iron contents in subsurface strata. The precise effects of these concentrations are not known in terms of plant nutrition if this material ends up in the plant rooting zone. Nickel and molybdenum also appear to occur in elevated concentrations, although the high iron contents might be expected to mitigate any problems with regard to these elements. These questions require further evaluation by the department and Spring Creek Coal Company.
5. The department will continue its evaluation of the overburden data with respect to the proposed mining plan and the federal act.

The air quality section will need further evaluation by the Health Department. The Department of State Lands with assistance of the Health Department will propose an expanded monitoring system for implementation during various project development phases.

A discussion of feasibility concerning mining of the Canyon coal seam is necessary in order for the Department of State Lands to evaluate your mining plan under the Coal Conservation Act. Items of concern include economics, equipment capability, reclaimed topography, special handling of toxic material and any other factor related to mining the Canyon seam.

There seems to be a discrepancy between the coal recovery rate stated on page 79 and that discussed on page 21. This problem should be cleared up.

The regraded contour map supplied with the application is too small to properly evaluate regraded contours. The Department requests a map of the scale of 1:400 showing regraded contour of your mine. The reclamation of facilities and scoria pit should also be shown on the regraded contour map.

The present map shows highwall reduction outside of the area to be mined. Backslopes out of the area to be mined should be eliminated where stability allows. Backfilling of the highwall areas is the accepted method of highwall reduction. The backfilling procedure reduces disturbed area, reduces the length of slope thereby decreasing erosion, and, since the steep bluff areas usually contain stands of trees and shrubs, these areas are usually better left untouched.

The encroachment of the mining operation on the steep and precipitous terrain poses a reclamation problem where ever it occurs. The steep slope terrain and its associated vegetation have been extremely difficult if not impossible to reestablish to date. Under section 26-2.10(10)-S10310 Mining and Reclamation Plan, (3) Buffer Zones, (a), the procedure when encountering steep and precipitous terrain is stated and should be followed.

Plate 13 from volume 2 entitled, "State Mine Plan, Bonding - Permit Map" shows associated disturbance in various areas outside of the coal lease area. The Department of State Lands does not wish to permit more area than is absolutely necessary for the mining operation. It does not appear that large areas to the South, West and North are necessary to conduct the mining operation. These areas contain steep and precipitous terrain and problems with any disturbance in these areas are great. All unnecessary area, especially that which contains steep slopes should be deleted from the permit application.

As you can see the review of your application was quite lengthy and involved numerous points which must be addressed. I suggest a meeting with the Department of State Lands staff after you thoroughly review the critique and application. Misunderstandings and corrections can be cleared up at such a meeting. After a meeting concerning the critique the appropriate corrections can be made.

Bear in mind that some problems may involve further research before a final decision can be made concerning your permit application.

The staff will complete their evaluation of the whole application for changes necessary under the Federal Strip Mining Act in the near future.

Sincerely,

Richard L. Juntunen
Coal Bureau
Reclamation Division

c: Dennis Hemmer
Neil Harrington
Mike Bishop
Craig Howard
Doug Heilman
Mike Eidlin
Ed Garrick
Brace Hayden
Leo Berry, Jr.

XI-104

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DEPARTMENT OF STATE LANDS

MAILING ADDRESS: CAPITOL STATION
OFFICE: 1625 11TH AVENUE

HELENA 59601

(406) 449-20

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COMMISSIONER

November 29, 1978

CERTIFIED MAIL NO. 22161

Mike Arne
Northern Energy Resources Company
P.O. Box 8451
Portland, Oregon 97207

Re: Application for Permit #00050 - Spring Creek Project

Dear Mr. Arne:

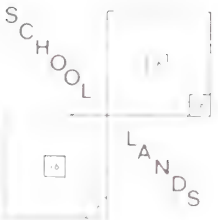
The Department of State Lands has reviewed your amended application for Permit #00050, received 8/3/78, as supplemented by material received 8/14/78. The submitted material has been reviewed for compliance with the Montana Strip and Underground Mine Reclamation Act, the pursuant adopted Rules and Regulations, the Coal Conservation Act, and the Rules and Regulations adopted pursuant to the Coal Conservation Act.

The application is deemed not complete at this time. The Department has listed specific deficiencies in your application. Each deficiency should be addressed with a positive commitment in your application. As explained in Dick Juntunen's letter of 12/16/77, all revisions must be in the form of complete replacement pages and/or plates. To avoid confusion, please label each replacement page with "Revised" and the date.

The following are the deficiencies in your application. Be as specific as possible in your response.

APPLICATION

1. A proof of publication is needed for the amended application.
2. Page I-8 - the description of the location of the mine site is incorrect for Sections 25 and 26.
3. Other Montana Permits, Page I-13 - Decker Coal Company also holds SMP 78001-C and Prospecting Permit 78010R.
4. Page I-23 - as pointed out in the previous letter of 1-12-78, the letter from S. L. Groff addresses an exploration permit.



MINING



MINING AND RECLAMATION PLAN

5. A commitment is needed that all materials not conducive to revegetation techniques, establishment, and growth shall not be left on the top or within eight feet of the regraded spoil surface, or at a greater depth as required by the Department, or at the surface of any other affected areas.
6. A commitment is needed that backfilled materials will be selectively placed and compacted wherever necessary to prevent leaching of toxic-forming materials into surface or subsurface waters in accordance with Rule S10330 of this subchapter and wherever necessary to ensure stability of the backfilled materials. The method of compacting material and the design specifications must be approved by the Department before the toxic materials are covered.
7. A commitment is needed that the transition from undisturbed ground will be blended with cut or fill to provide a smooth transition in topography.
8. The regraded contours for the railroad loop are unacceptable. Reclaimed roads and railroads must comply with S10310(4)(i).
9. A commitment is needed that, on access roads, cut slopes shall not exceed 2:1 in soils or 1/2:1 in rock.
10. A commitment is needed that all mining activities including highwall reduction shall cease 100 feet from a permanent structure, unmineable, steep, or precipitous terrain, or any area determined by the Department to be of unique scenic, historical, cultural or other unique value.
11. On page III-10 - a discussion of topsoil salvage occurs which is somewhat inconsistent with that on page III-11 primarily in the use of the word "topsoil." This confusion should be cleared up. See the comment in this letter under Topsoiling, item 3, for guidance.
12. On page III-10 and III-11 - the discussion of sodic overburden materials with respect to the alleged presence of sandy textures does not appear to be supportable by the overburden data. Also, the relevancy of the presence of quartz in the sandstone as presented in the discussion is unclear. Please see further discussion of the sodic overburden in the section of this letter labeled Overburden.
13. Page III-12 - what is proposed to be done in the face of a scarcity of backfill material, to spot fill areas of subsidence which might occur during the years immediately following final reclamation grading?
14. Page III-36 through 77 (Water Quality) - all designs for all ponds, discharge structures, ditches, etc., should be submitted, with supporting calculations, in such detail

as to allow a construction crew to build them. Specifically, a scale map should be submitted showing the catchment area which contributes runoff to each drainage control structure with calculations to show that each structure is sufficient to meet appropriate requirements. The designs should include, but not necessarily be limited to, the following:

- a. Sediment storage volume in the ponds (S10330(6)(c)).
 - b. Anticipated sediment removal plan (if any) (S10330(6)(f)).
 - c. Spillway type and method of control (S10330(6)(d),(e) and (g)(i)).
 - d. Combination of principal and emergency spillway for ponds greater than 20 acre-feet in volume (S10330(6)(g)(i)).
15. The Department urges NERCo to shift the haul road and the railroad loop, if necessary, to the north in order to prevent the road fill from impinging on the drainage channel. If NERCo can demonstrate that the movement of the roadfill is not possible, the Department will entertain a proposal to divert the drainage only if the gradient and channel configuration are preserved. If the diversion approach is taken, NERCo should also describe the stability of the materials in which the stream will be relocated.
16. There is no discussion of topsoil salvage and disposition along the railroad corridor. Stockpile locations of topsoil salvaged as part of the railroad spur construction should be shown and will require permitting. The Department feels that cut and fill slopes of the railroad spur, except in consolidated rock, should be topsoiled and revegetated for the life of the mine.

BLASTING

17. Public notice of the blasting schedule must be sent to each residence within 1 mile rather than 1/2 mile.
18. The blasting formula is wrong as presented. The formula should be
19. Page III-32 - insert "13" after "Figure."
20. Page III-34 - item number 6 should include the words "or leased" after the word "owned."

HYDROLOGY21. Alternative water supplies

- a. NERCo has shown that the water quality of the Canyon coal aquifer is comparable to the Anderson-Dietz as a replacement water source; however, the hydraulic properties of this aquifer (data) which indicate it will serve as an adequate water source (quantity and well yield) must be provided.

22. Response to letter sent to Rick Kent (Senior Geologist)

- a. A well (SC-400W) completed in the overburden zone was requested for section 22 cad. A well at this location was apparently completed into the Anderson-Dietz instead of the overburden. This is unacceptable with regards to the data that were requested. A new well in the requested location completed in the overburden is needed.
- b. Single well recovery tests were requested for each new well. These data have not been received. Include any pump test data from the facilities wells.
- c. The question about the hydrogeologic effect of the Spring Creek fault has not been answered. Data must be presented to answer this question. Additional data may have to be collected if NERCo does not have these data available.
- d. A pump test was requested for well #372 to determine the hydraulic properties of the interburden. This information was not included. The hydraulic properties of the interburden are very important in determining whether or not low quality water from the base of the pit (during mining and after reclamation) will move down through the interburden and mix with the water in the Canyon coal. This must be known if the Canyon coal is to be considered as an alternative source.

Items 23-27 below are pursuant to DSL's letter of 1/12/78 to NERCo

- 23. Well logs of each facilities well should be provided to answer the question of geologic source of water for mine personnel use.
- 24. NERCo should commit to stake the sediment ponds so that the department will be able to determine if sediment is being removed as necessary (Question 9).

25. The question (number 11) about postmining management scheme pertaining to water use and availability was not addressed.
26. Question 12 on the water quality analyses was not addressed. NERCo must show that the error in the cation-anion balance for the groundwater and surface water analyses does not exceed 5%. The submitted water quality data appear to be unacceptable. All new water quality data should be submitted (November 1977, June 1977, etc.).
27. Comments provided by Fred Shewman, of the State's Water Quality Bureau, apparently were not responded to in detail. NERCo should indicate where in the narrative each question was answered or submit answers to these questions.
28. At the present time, the alluvial aquifer system (South Fork), is not well understood. The hydrogeologic properties of this aquifer with respect to hydraulic connection with the overburden, recharge to and discharge from the alluvium, and the hydrogeologic controls governing the movement of water to the alluvium must be well understood.
29. In section 3.1 of the application, Generalized Groundwater Basin Study, it is stated that "the greatest amount of recharge to the coal occurs along the burn-line at the northeast edge of the site." This statement does not totally agree with the water level contour map (Figure I-18). The greatest amount of recharge appears to come from the northwest along the Spring Creek fault. The recharge to the coal aquifer must be understood. An explanation of how recharge was determined should be included.
30. NERCo should submit hydrologic logs of all new groundwater monitoring wells. Under Section 3.2.3, Groundwater level monitoring, of the Spring Creek project hydrology (page 9), there are some questions about well #349.
 - a. How was the well completed (aquifers)?
 - b. The overburden apparently was drained by the drill hole? Was the seal broken?
31. Alluvial Valley Floor

Regardless of whether or not Spring Creek and the South Fork Spring Creek meet the preliminary criteria of alluvial valley floors, these hydrologic systems must be well understood. The alluvial hydrologic systems and the South Fork Spring Creek must be studied to determine whether or not and to what extent mining will impact these systems. These evaluations must include all runoff from the proposed mine areas that will supply water, as surface flow and groundwater recharge, to the valley systems. It is very important to determine whether runoff from the proposed

mine areas supplies a significant amount of water to the alluvial systems or whether precipitation water infiltrates into the overburden groundwater systems before entering the alluvium. This should include an evaluation of the proportion of the surface area draining into South Fork from the area to be mined compared to the area not to be mined.

32. The post-mining contour map should take into account the drainage area that supplies runoff to Spring Creek and the South Fork Spring Creek under pre-mining conditions. The runoff or infiltration over these areas, if found to be significant to the overall hydrologic balance of these alluvial systems, would have to be restored after mining. The post-mining drainage plan should provide runoff at approximately the same locations as it enters the valley under pre-mining conditions.
33. The Department is concerned about the possible water degradation problems associated with the saline portions of the upper overburden. McWhorter, et. al. (date?) indicated in hydrologic studies in Colorado that a fairly good correlation existed between EC's of saturation extracts of overburden and subsequent subsurface mine drainage waters. The Department is investigating this problem further in cooperation with the Montana Bureau of Mines and Geology. Any relevant information that could be supplied by NERCo would be appreciated.

Reference Cited

McWhorter, D. B., J. W. Rowe, M. W. Liew, R. L. Chandler, R. K. Skogerboe, D. K. Sunada, and G. V. Skogerboe. Date? Surface and Subsurface Water Quality Hydrology in Surface Mined Watersheds. Report prepared for Office of Research and Development, E.P.A., Cincinnati, Ohio.

TOPSOILING

34. John Phillips indicated that Table 12 in the topsoiling section showing volume estimates of the various mapping units included the actual mine area only. The Department would like the same evaluation of the facilities area, roads, the railroad spur, and the scoria pit.
35. On Page III-78 - under the heading Topsoil Removal, the indicated salvage of topsoil under topsoil stockpile sites should not be done and reference to this should thus be omitted in the paragraph.

36. On Page III-78 and III-79 - the discussion concerning two-lift topsoil salvage should be rewritten to reflect current Department of State Lands' regulations (S10340). The paragraph on III-79 implies that B and C horizon will not be salvaged unless directed to do so by the Department. This does not reflect current regulations. Spring Creek Coal Company shall salvage all available topsoiling material (A, B, and C horizons), unless any of it is demonstrated to have unsuitable characteristics.

In addition, the first lift of topsoil salvaged should not necessarily be an across-the-board 6 inches for all soils, but should reflect the site specific soil types present on the mine. Accordingly, Spring Creek Coal Co. should make a revised evaluation and/or discussion of the initial lift.

37. On page III-83 - last paragraph, 1st line, change "approximately" to "within".
38. Pursuant to S10340(5), a commitment that "Extreme care shall be exercised to guard against erosion during application (of topsoil) and thereafter" should be made.
39. Pursuant to S10340(7), a commitment that "Spring Creek Coal Co. shall take all measures necessary to assure the stability of topsoil on graded spoil slopes" should be made.

SOIL SURVEY REPORT

40. There were a number of errors of commission and omission throughout the soils survey report that should be corrected. For example, on page A-9, the symbol for Isolated Rock Outcrops is missing. The legal descriptions for the locations of Allevert loam and Wixen stoney loam profiles are incomplete. There is no mapping unit description given for Allevert loam (22).
41. There are several new soil series described in the soils report. Please provide information on how these soil series were separated out from the original set of soil series.
42. On page A-36, mapping unit 12 is described but is not included on any map legend. Please explain.
43. In the SW1/4 of Section 29, on both the 1" = 400' map and the 1" = 1000' color map, a unit designated 6R is mapped but it is not in the legends nor does it have a description in the report.
44. After the meeting on October 26 between DSL and NERCo personnel, it is the Department's understanding that Spring Creek Coal Co. is planning to sample the soils for

analysis prior to salvage on a 100-foot grid basis. The Department agrees with and encourages this approach. Please indicate this procedure more fully in the appropriate portion of the Mining and Reclamation Plan.

OVERBURDEN

45. At the October 26 meeting between DSL and NERCo personnel, it was indicated by NERCo that the deep ripping of spoils surfaces prior to topsoiling would serve to mitigate the impermeable characteristics of sodic spoils. DSL would like documentation of this assertion based on available data or information from other mines with similar sodic overburden. Included in this should be any observations relative to the long-term effectiveness of this technique in aiding sodic spoils permeability, allowing root penetration, vegetative performance of different species in such situations, etc.
46. The Department is also concerned about the possibility of upward migration of sodium salts from sodic overburden, thus deteriorating the quality of overlying topsoiling material.

Do you have any data available at other mines that could throw some light on this question?

47. What is NERCo's response to the portion of the CSMRI report dealing with potential molybdenum problems in the overburden?

METEROLOGY AND AIR QUALITY

48. The Department requests that NERCo submit all available on-site precipitation data and to submit updates of the hi-vol and other met data.
49. The present met site will be disturbed in the initial phases of mining and will need to be relocated. Discussions with Dave Maughan of the Air Quality Bureau indicated that the met site should be moved to a site within the proposed permit area east or northeast of the present site. In addition, Dave suggested that two hi-vol sites downwind and one upwind of the permit area should be established, the exact locations of which could be better determined by a joint meeting with NERCo, DSL, and the Air Quality Bureau.

PLANTING AND REVEGETATION

50. In several places in the Reclamation Plan, it was stated that the primary post-mining land use would be livestock grazing. Section 12 of the Montana Act states"

After the operation has been backfilled, graded, topsoiled, and approved by the Department, the operator shall prepare the soil and plant such legumes, grasses, shrubs, and trees upon the area of land affected as are necessary to provide a suitable permanent diverse vegetative cover capable of:

(a) feeding and withstanding grazing pressure from a quantity and mixture of wildlife and livestock at least comparable to that which the land could have sustained prior to the operation; (emphasis added)

The Backfilling and Grading (III-5), Planting and Revegetation (III-87), and Postmining Uses (III-118) sections should be changed to reflect this cited portion of the statute.

51. Page III-91 - in the paragraph titled Seasonal Vegetation Cover, the first sentence states, "In all disturbed areas, excluding those for which exceptions have been granted,..." It is unclear what these "exceptions" are.
52. Page III-94 - Forbs should be seeded throughout the area preferably broadcast. A definite forb seeding mixture should be developed based on the species available. NERCo should strive to develop seed sources for other desirable forb species and update the mixture as other species become available.
53. Page III-94 - NERCo should commit to selectively placing coarse-textured substrate in areas where Ponderosa pine are to be planted.
54. Page III-94 - NERCo should commit to selectively placing coarse-textured substrate in areas where Rhus is to be planted. The Department strongly recommends using seedlings of skunkbush rather than seed. Establishment of skunkbush from seed has shown very poor success.
55. More relief in the regraded contours is needed to achieve vegetation diversity and to provide wildlife habitat. NERCo should commit the majority of the spoils being held as a reserve for use in reclamation. Tributary drainages, swales and ridges would give topographic diversity which would aid vegetational diversity. Shrubs could be planted in the tributaries which would add wildlife cover. Rock-

piles could be placed on the ridges providing raptor perches.

56. Page III-90 - It is unclear if the "if available" in Table 15 applies only to the Elymus cinereus or to the Elymus cinereus and the following three species. While it is difficult to predict availability, NERCo should make every effort to ensure the availability of all four species as they will be necessary to achieve reclamation of wildlife habitat. This may require contracting the propagation of seedlings of these species.
57. In order to provide wildlife habitat comparable to that present prior to mining, NERCo should commit to plant larger areas of Big sage (Artemesia tridentata) so that a comparable amount of habitat is restored.
58. Mulching and cover crops should be planted both spring and fall on slopes over 10:1. If it is demonstrated to the Department's satisfaction that this is unnecessary at some point in the future, this requirement will be relaxed.

WILDLIFE

59. At this point in time, data weaknesses exist in clear documentation of antelope and mule deer fawning and fawn rearing sites. These data can only be supplied by precise observational methods specific to fawn and fawn rearing information or by radio telemetry of fawning does with subsequent follow-up observations. A radio telemetry study on these mammals would also provide exacting data concerning antelope and mule deer movement. If we simply use spring concentration areas as an indication of fawning areas, then a NE portion of the mine lies in a mule deer and antelope fawning and fawn rearing area.
60. The nocturnal movements of mule deer have not been defined to date. As the mine area is essentially surrounded by mule deer concentration areas, NERCo should investigate different techniques to provide such data.
61. The presence of numerous important use areas such as sage grouse and sharp-tail leks as well as mule deer and antelope wintering and fawning areas, including raptor use of the area, needs to be addressed in terms of Section 50-1042 of the Act, subsections 1 and 2 in particular. In that the Department cannot approve applications for permit when the land contains characteristics mentioned in this specific section of the Act, NERCo should address each important use area with an explanation of why NERCo feels

the area does not meet the criteria of Section 50-1042, 1 and 2.

62. The present reclamation plan as it provides for wildlife is unacceptable. Major problems exist in revegetation concerning lack of sagebrush, shrubs and other vegetation in quantities similar to those that existed prior to mining. The post-mining vegetation should provide food and cover for those wildlife species on the site after mining at least comparable in amount to the food and cover available prior to mining. Bond release will be based on these criteria. Successful wildlife reclamation is a must for bond release.
63. The lack of topography and diversity of soils is another reclamation aspect that needs to be addressed. Diversity of topography is needed in the central plain. Without some relief the area may never provide the habitat necessary for some wildlife species similar to that which existed before mining. Soils diversity is a related problem with topography. For plant species such as skunkbush, pine, juniper and others, salvage and deposition of specific soils and soil substrates may be necessary in reclamation to provide long-term regeneration of these plants. NERCo should address the soils and topographic diversity problems with special salvage and reclamation plans.

BONDING

64. The proposed bonding level is insufficient. Section 6 subsection (8)(b) requires ". . .in no event shall the bond be less than the total estimated cost to the state of completing the work described in the reclamation plan." NERCo's application indicates that it would cost the state more to reclaim both mining level and facilities level disturbance than the proposed level. The bond must be increased to the amount it would cost the state to reclaim the area.
 - a. All mine level disturbance must be bonded at \$16,102 per acre.
 - b. All facility level disturbance must be bonded at \$5,655 per acre.
65. Any road from which topsoil will be removed must be bonded at facilities level.
66. A map is needed showing the area that will be permitted and bonded for the railroad spur. This information should be a topographic map showing the exact location.

67. There is some question whether the two new water wells are in the area bonded at facilities level.
68. Unless further justification is furnished, all area south of the north buffer zone along the South Fork of Spring Creek should be deleted from the permit area.
69. Roads, railroads, surface facilities, sediment ponds and all mining related disturbances should be clearly marked and labeled on the bonding map (Plate 4).

ARCHAEOLOGY

70. All state and federal archaeological concerns must be satisfied prior to a permit decision. Details of these concerns can be found in the DSL letter of January 12, 1978 to NERCo, a letter dated July 12, 1978, from Ken Korte of the Montana Historical Society to Edwin Zaidlicz of the BLM (can be found in the draft EIS) and in Mr. Neuberg's reply dated July 25, 1978. A copy of this reply is enclosed.
71. In addition, the disposition of the two tepee rings recently discovered along the railroad corridor adjacent to the reservoir must be addressed.

POST-MINING CONTOUR MAP

In addition to the concerns already detailed earlier with regard to post-mining topography, a few remain.

72. On plate 19, regraded contours are shown in the far south-eastern portion of Section 30 that will apparently not be disturbed by the actual mining operation. Please explain. In any case, these contours blend poorly with existing topography.
73. Provision must be made in the 5:1 slopes in the northern and western portions of the mine (plate 19) for water draining from the adjacent undisturbed coulees onto these regraded slopes. This would involve a continuation of the coulees into the reclaimed topography to give a better blending of contours. This should be shown on the post-mining contour map.
74. The Department's concerns relative to the reclamation of the scoria pit as stated in the January 12, 1978, DSL letter, page 11, item 2, have not yet been addressed completely.

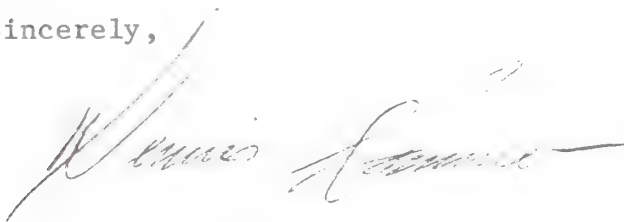
As currently depicted on the post-mining topography map (plate 19) the reclaimed coulee from the scoria pit drains into the side of a ridge. Plans for reclamation of the settling pond should be shown and committed to in the narrative.

VOLUME 2 - PLATES

75. Permit application areas on Plates 2 and 3 do not correspond to that on Plate 1.
76. Plate 4 - the permit map should clearly show and label:
 - a. haul and access roads;
 - b. dragline corridors;
 - c. stream crossings;
 - d. spoil and topsoil stockpiles;
 - e. major structures; and
 - f. ponds.
77. Plate 20 - the drainage plan must include complete drainage and sedimentation facilities for the rail loop, spur, tippie, haul road and access roads, and other facilities bonded at the facilities level.
78. Plate 23 - the mining plan narrative should explain why the Anderson-Dietz seams can not be mined to the lease boundary.

If you have any questions or if we can be of any assistance, please do not hesitate to contact our office.

Sincerely,

A handwritten signature in dark ink, appearing to read "Dennis Hemmer", with a long horizontal flourish extending to the right.

Dennis Hemmer, Chief
Coal Bureau
Reclamation Division

NH:lw

enclosures

C: Don Crane
Dennis Hemmer
Brace Hayden

DEPARTMENT OF STATE LANDS

MAILING ADDRESS: CAPITOL STATION
OFFICE: 1625 11TH AVENUE

HELENA 59601

(406) 449-2074

December 20, 1978

STATE BOARD OF
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MIKE GREELY
ATTORNEY GENERAL

V. "SONNY" OMHOLT
AUDITOR

Don Crane, Regional Director
Office of Surface Mining
Department of the Interior
Old Post Office--downtown
1823 Stout Street, Room 270
Denver, CO 80202

Re: Alluvial Valley Floor Determination for Proposed
Spring Creek Mine Site

Dear Don,

Attached is the Department of State Lands preliminary alluvial valley floor determination for Spring Creek and the South Fork of Spring Creek adjacent to Spring Creek Coal Co.'s (NERCo's) proposed permit area.

The Department has split the Spring Creek alluvial valley issue into two determinations. Data needed to assess the impact of NERCo's existing mine plan proposal on potential alluvial valley floors adjacent to their mine area was requested in the November 29th deficiency letter to NERCo. Data requested in attached letter is designed to facilitate final alluvial valley floor determinations on the two creeks in question should NERCo propose to mine through them in the future.

The Department forwards the attached draft document for review by your staff. If you have any questions please contact Jim Osiensky in our office.

Sincerely,



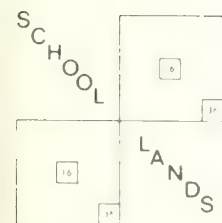
Brace Hayden, Administrator
Reclamation Division

c: Leo Berry
Dennis Hemmer
Jim Osiensky

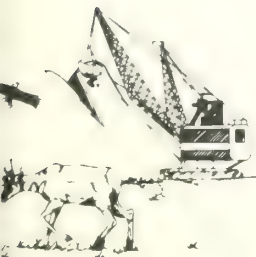
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LEO BERRY JR
COMMISSIONER



MINING



RECLAMATION



STATE OF MONTANA

DEPARTMENT OF STATE LANDS

MAILING ADDRESS: CAPITOL STATION
OFFICE: 1625 11TH AVENUE

HELENA 59601

(406) 449-207

December 20, 1978

Mr. Mike Arne
Northern Energy Resources Co.
P.O. Box 8451
Portland, Oregon 97207

Re: Potential Alluvial Valley Floor(s) at the Proposed
NERCo Mine Site

Dear Mr. Arne:

The Department of State Lands has made preliminary alluvial valley floor determinations for Spring Creek and the South Fork Spring Creek. These Determinations are based on the geomorphic characteristics of these valley floors. Additional data are needed so that final determinations can be made as to whether or not Spring Creek and the South Fork Spring Creek are indeed alluvial valley floors, and what the essential hydrologic functions are that must be protected.

NERCo should provide adequate data, descriptions, diagrams, etc. which thoroughly substantiate all conclusions pertaining to the alluvial valley floor determinations (i.e. procedures and methods followed in mapping the alluvium, subirrigated areas, vegetation, etc.).

Following are the comments pertaining to potential alluvial valley floors at the proposed NERCo Spring Creek Mine site.

COMMENTS:

A preliminary determination that Spring Creek and the South Fork Spring Creek are alluvial valley floors has been made by the Department of State Lands (based on geomorphic characteristics). These preliminary determinations are based upon the definition of "alluvial valley floors" in Section 701 of the Federal Act and the draft guidelines for the Technical Identification and Study of Alluvial Valley Floors proposed by the Office of Surface Mining (OSM). The following discussion presents the reasoning by which these preliminary determinations were made.

STATE BOARD OF
LAND COMMISSIONERSTHOMAS L. JUDGE
GOVERNORGEORGIA RICE
SUPT. OF PUBLIC INSTRUCTIONFRANK MURRAY
SECRETARY OF STATEMIKE GREELY
ATTORNEY GENERALE. V. "SONNY" OMHOLT
AUDITORLEO BERRY JR.
COMMISSIONER

MINING



RECLAMATION

1) Unconsolidated stream laid deposits

"Alluvial valley floors: means the unconsolidated stream laid deposits holding streams where water availability is sufficient for subirrigation or flood irrigation agricultural activities but does not include upland areas which are generally overlain by a thin veneer of colluvial deposits composed chiefly of debris from sheet erosion, deposits by unconcentrated runoff or slope wash, together with talus, other mass movement accumulation and wind blown deposits. Both Spring Creek and the South Fork Spring Creek have valleys composed of unconsolidated stream laid deposits which hold streams.

2) Stream channels

A stream channel is a defined water course which carries streamflow at some times of a year. Both Spring Creek and the South Fork Spring Creek have identifiable stream channels as shown on the USGS 1:24000 topographic quadrangle. Both creeks have channels that are wider and deeper than the bankfull width and depth (3 feet wide and 0.5 feet deep) used as the cutoff dimensions in the OSM guidelines.

3) Active Flood Plain

An active flood plain is that flat area constructed by the present river in the present climate (Leopold, 1974). Both Spring Creek and the South Fork Spring Creek have identifiable flood plains.

4) Terraces

A terrace is a former flood plain no longer being actively constructed by the river in the present climate (Leopold, 1974). Both Spring Creek and the South Fork Spring Creek have identifiable stream terraces which were formed at some time in the past by the streams in question.

Additional data are needed in the form of accurate maps (scale not greater than 1"=600') of all alluvial material (active flood plains, terraces and possibly alluvial fans) which may be considered to be part of an alluvial valley floor at Spring Creek and the South Fork Spring Creek (see OSM guidelines). Stereo aerial photographs of the valley floors and adjacent lands should be provided so the Department can study these potential alluvial valley floors and check the mapping of the alluvium. Infrared aerial photographs of these same areas should also be provided (preferably during moisture stress).

Part I. B. Water Availability Characteristics

Although both Spring Creek and the South Fork Spring Creek meet the geomorphic characteristics of alluvial valley floors, the water availability characteristics of these valley floors must be further evaluated.

The productivity of the alluvial areas vs. adjacent upland areas, as well as the productivity of the subirrigated alluvial areas vs. the non-subirrigated alluvial areas should be evaluated. The potential for farming on these valley floors (if irrigation water is available) must be protected.

The total amount of runoff that occurs from the proposed mine area relative to the total drainage areas supplying water to the alluvium in the valleys of Spring Creek and the South Fork Spring Creek should be evaluated so a determination can be made as to whether or not the essential hydrologic functions will be preserved, or can be restored after mining.

The water availability characteristics of the valleys of Spring Creek and the South Fork Spring Creek should be evaluated as step 2 in the determination of potential alluvial valley floors (see OSM guidelines).

1) A determination of the volume of flood flow water that would be available for irrigation should be made for both Spring Creek and the South Fork Spring Creek. These determinations should be based on Part I.B. of the OSM guidelines. "Estimates of water availability should be based on streamflow analyses, drainage basin, or channel geometry characteristics." NERCo should compare the estimates of streamflow for Spring Creek and the South Fork Spring Creek (shown on Figure 11-28 for the Hydrology-Spring Creek Project) with estimates based on channel geometry methods. (Hedman and Kastner, 1977; and Lowham, H.W., 1976).

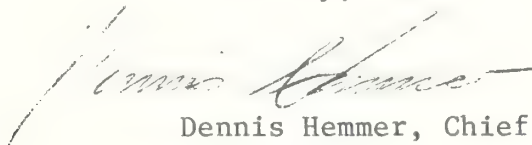
The channel geometry technique (depth and width of active channel) gives a good indication of the amount of water that actually flows down the channel and is potentially available for flood irrigation.

Water availability should be evaluated assuming that the crop to be irrigated as alfalfa which has a consumptive use of approximately 26 inches of water for an entire growing season (Soil Conservation Service (1974)) in the area. This amount of water includes precipitation that falls during the growing season.

2) The area along the South Fork Spring Creek that may potentially be subirrigated should be determined and mapped. This determination should be based on the assumption that the primary crop would be alfalfa. A depth to water map should be constructed for the entire area of alluvial material. The capillary conductivity of the alluvial material should be determined. Because of the lack of a water table in the alluvium along Spring Creek, subirrigation should not be a consideration in the water availability study of this valley.

If either Spring Creek or the South Fork Spring Creek is determined to be an alluvial valley floor, NERCo must show to the satisfaction of the Department that disturbance to the prevailing hydrologic balance at the mine-site and in associated off-site areas will be minimized, and that the essential hydrologic functions of the alluvial valley floor(s) will be preserved or restored.

Sincerely,

A handwritten signature in dark ink, appearing to read "Dennis Hemmer", is written over a light gray rectangular background.

Dennis Hemmer, Chief
Coal Bureau
Reclamation Division

JO:lw

**Advisory
Council On
Historic
Preservation**

1522 K Street NW.
Washington D.C.
20005

November 17, 1978

Mr. Edwin Zaidlicz
State Director
Bureau of Land Management
Federal Building & U.S. Courthouse
222 N. 32nd Street, P.O. Box 30157
Billings, Montana 59107

Dear Mr. Zaidlicz:

We have been informed that the Spring Creek Mine under the jurisdiction of the Miles City District Office is an undertaking assisted or licensed by the Bureau of Land Management which may have an effect on petroglyph site 24BH1046 which may be eligible for inclusion in the National Register of Historic Places.

Please investigate this matter to determine whether the nature of the effect requires that you obtain the comments of the Council in accordance with Section 106 of the National Historic Preservation Act of 1966 (16 U.S.C. 470f, as amended, 90 Stat. 1320). Steps to determine this responsibility are set forth in Section 800.4 of the Council's "Procedures for the Protection of Historic and Cultural Properties" (36 CFR Part 800).

The Council requests that you report the results of your investigation to this office at the earliest opportunity. If you have further questions or require assistance, please call Brit Allan Storey of the Council's Denver Office at (303) 234-4946, an FTS number.

Thank you for your cooperation.

Sincerely,


Louis S. Wall
Assistant Director
Office of Review and Compliance, Denver

APPENDIX T



United States Department of the Interior

BUREAU OF LAND MANAGEMENT
222 North 32nd Street
P.O. Box 30157
Billings, Montana 59107

In reply refer to:
8143 (931)

Mr. Louis S. Wall
Office of Review and Compliance
Advisory Council on Historic
Preservation
P.O. Box 25085
Denver, Colorado 80225

NOV 27 1978

Dear Mr. Wall:

In response to your inquiry of November 17 on the Spring Creek Mine, the Bureau of Land Management does currently have an application before them from Northern Energy Resources Company for a coal mining permit. The petroglyph site 24BH1046 as well as several other sites may be affected by this mine plan. The BLM has been in constant communication with the State Historic Preservation Office on this matter and is currently awaiting submission of complete inventory results and proposed protection measures from Northern Energy's contracting archeologist. Upon receipt, the BLM will then complete all the necessary 106 compliance documentation and obtain your comments. Facilities construction will not occur on the mining plan area until all of the proper protection measures have been completed.

If you have further questions on this matter, please do not hesitate to call.

Sincerely yours,

Kannon Richards
Acting State Director

cc:
DM, Miles City

**Advisory
Council On
Historic
Preservation**

APPENDIX T

1522 K Street NW.
Washington D.C.
20005

January 4, 1979

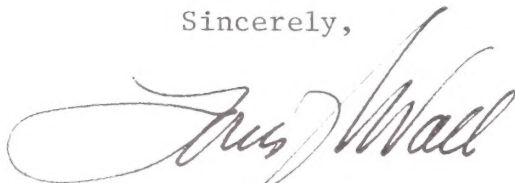
Mr. Kannon Richards
Acting State Director
Bureau of Land Management
P. O. Box 30157
Billings, Montana 59107

Dear Mr. Richards:

This is to acknowledge your undated letter, received in our office on November 30, 1978, explaining that the Bureau of Land Management will comply with Section 106 of the National Historic Preservation Act, as amended, with regard to the Northern Energy Resources Company's Spring Creek Mine. We appreciate your prompt response to our inquiry and look forward to working with the Bureau in accordance with the "Procedures for the Protection of Historic and Cultural Properties" (36 CFR Part 800) at the appropriate time.

If we may be of assistance to the Bureau or should you have any questions regarding the Procedures, please call Brit Allan Storey of our staff at (303) 234-4946, an FTS number.

Sincerely,



Louis S. Wall
Assistant Director
Office of Review and Compliance, Denver

